SCIENTIFIC AMERICAN

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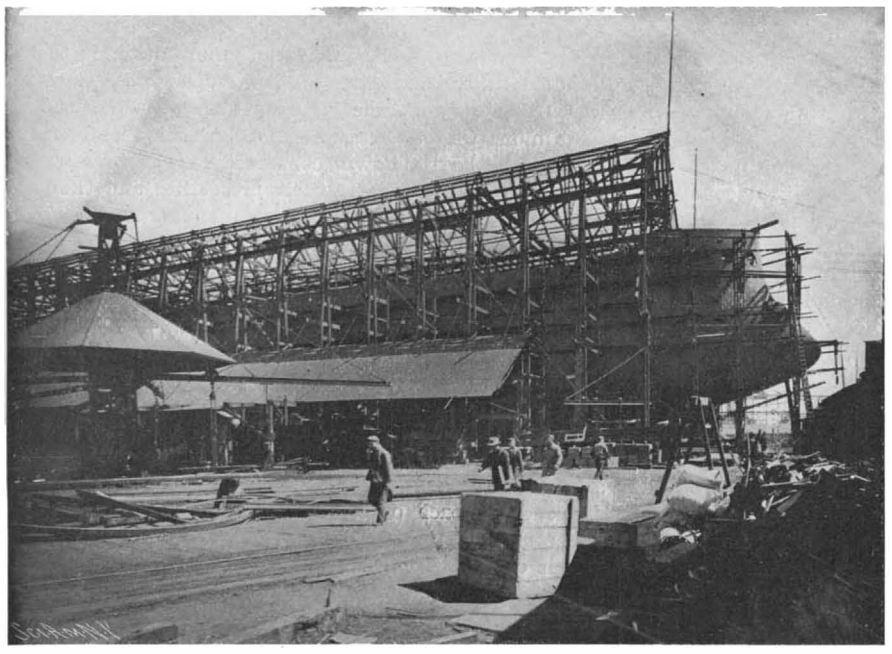
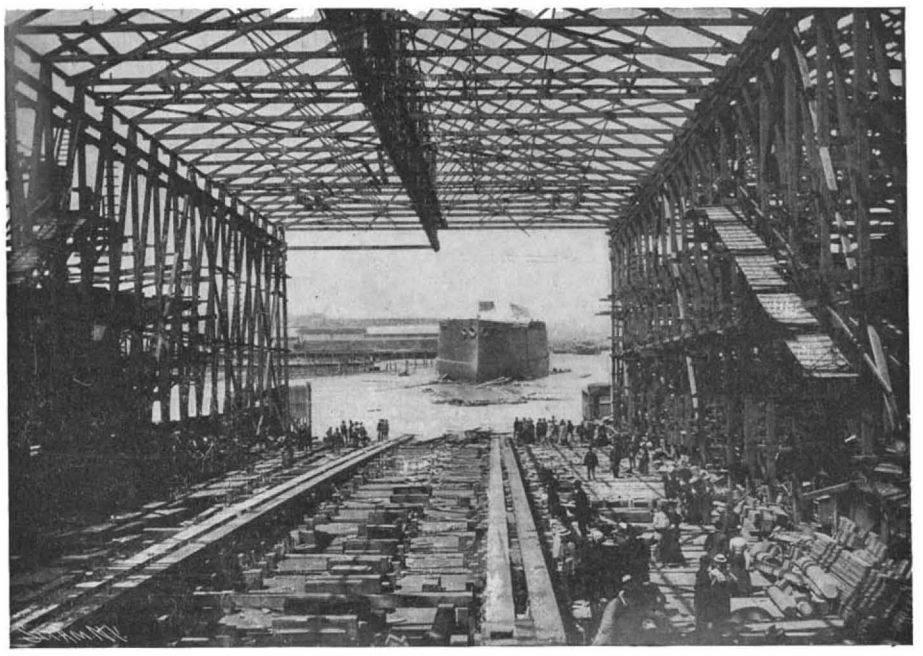
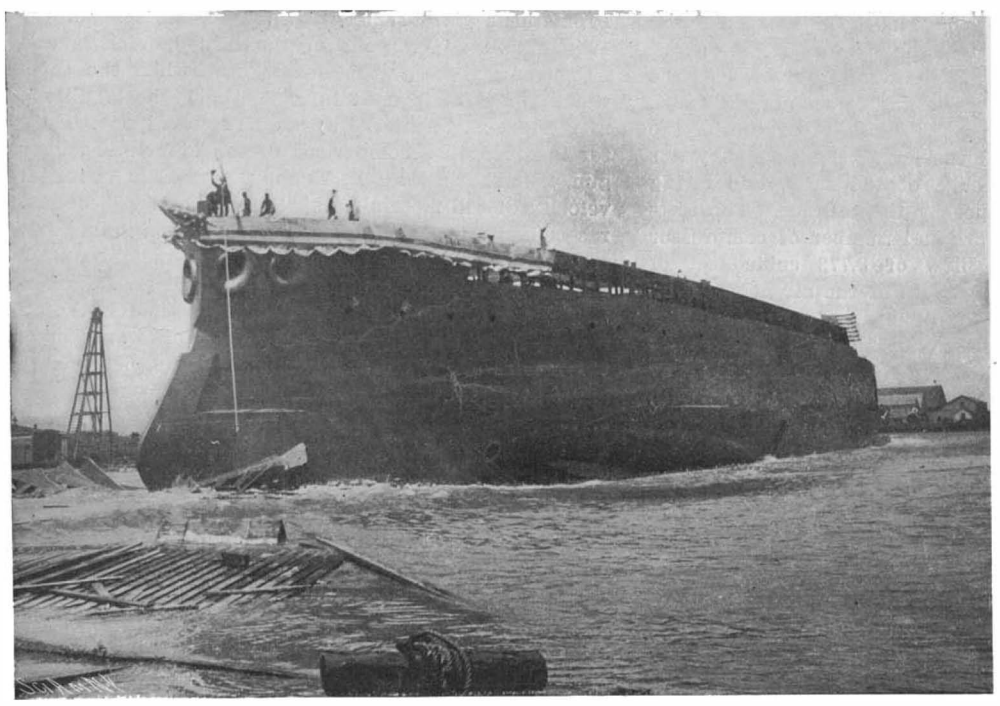


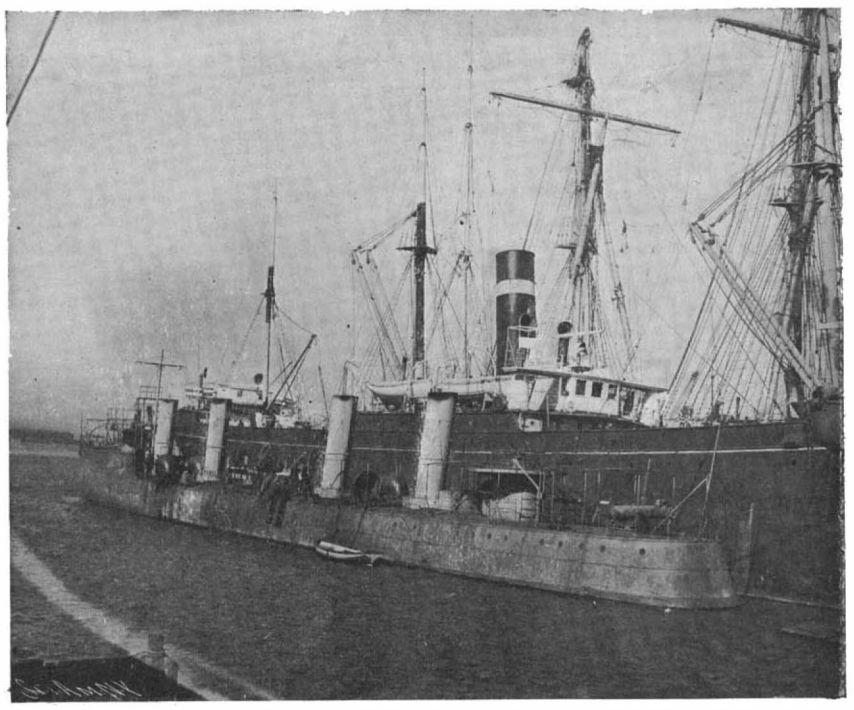
The "Ohio" on the Stocks.



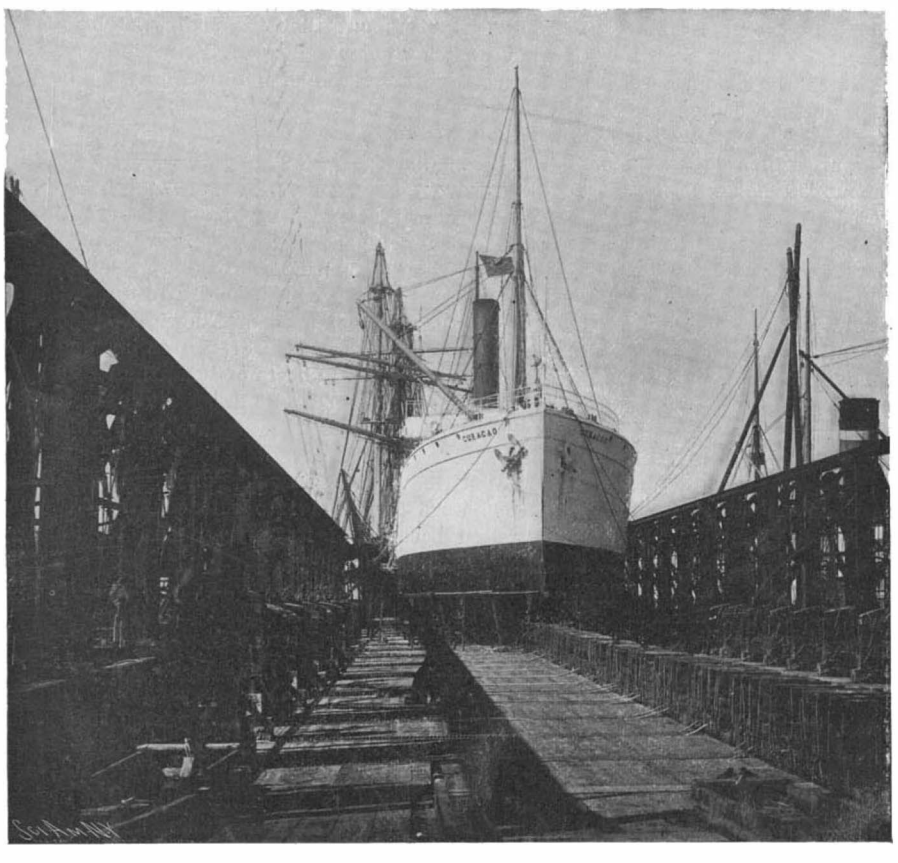
The "Ohio" Afloat—View Looking Down the Ways from the Launch Platform.



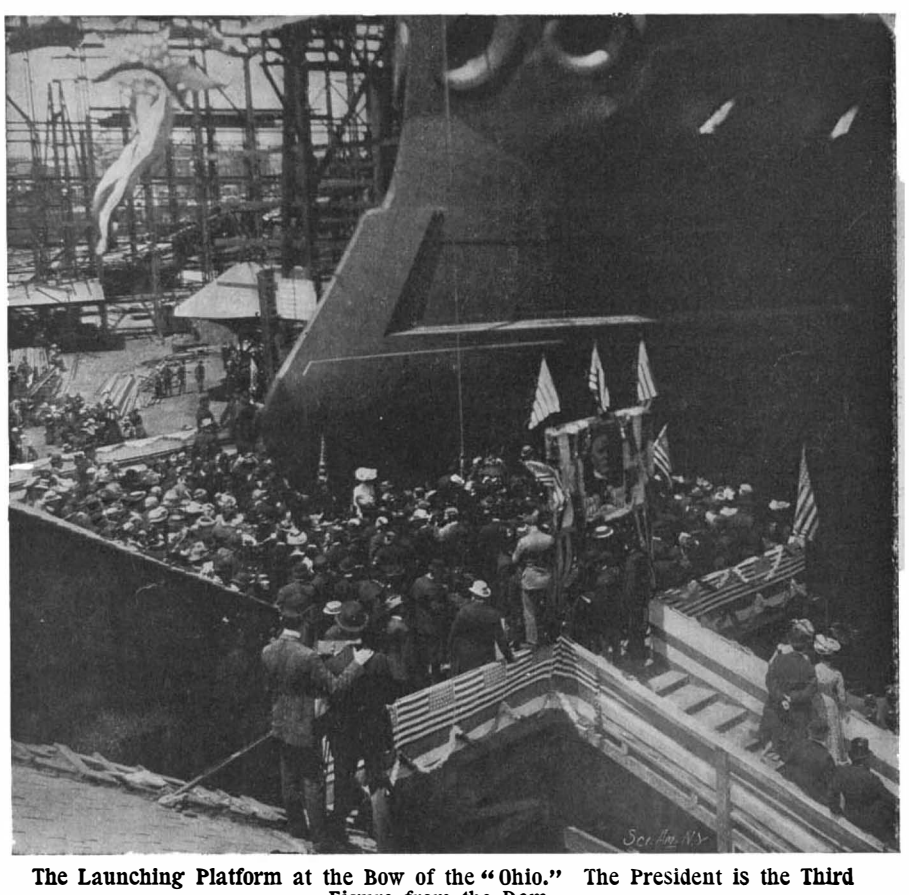
The "Ohio" Immediately After the Launch.



Torpedo-Boat Destroyer "Perry," Constructed at the Union Iron Works.



The Hydraulic Dry-Dock at the Union Iron Works.



The Launching Platform at the Bow of the "Ohio." The President is the Third Figure from the Ram.

LAUNCH OF THE BATTLESHIP "OHIO" AT THE UNION IRON WORKS.—[See page 359.]

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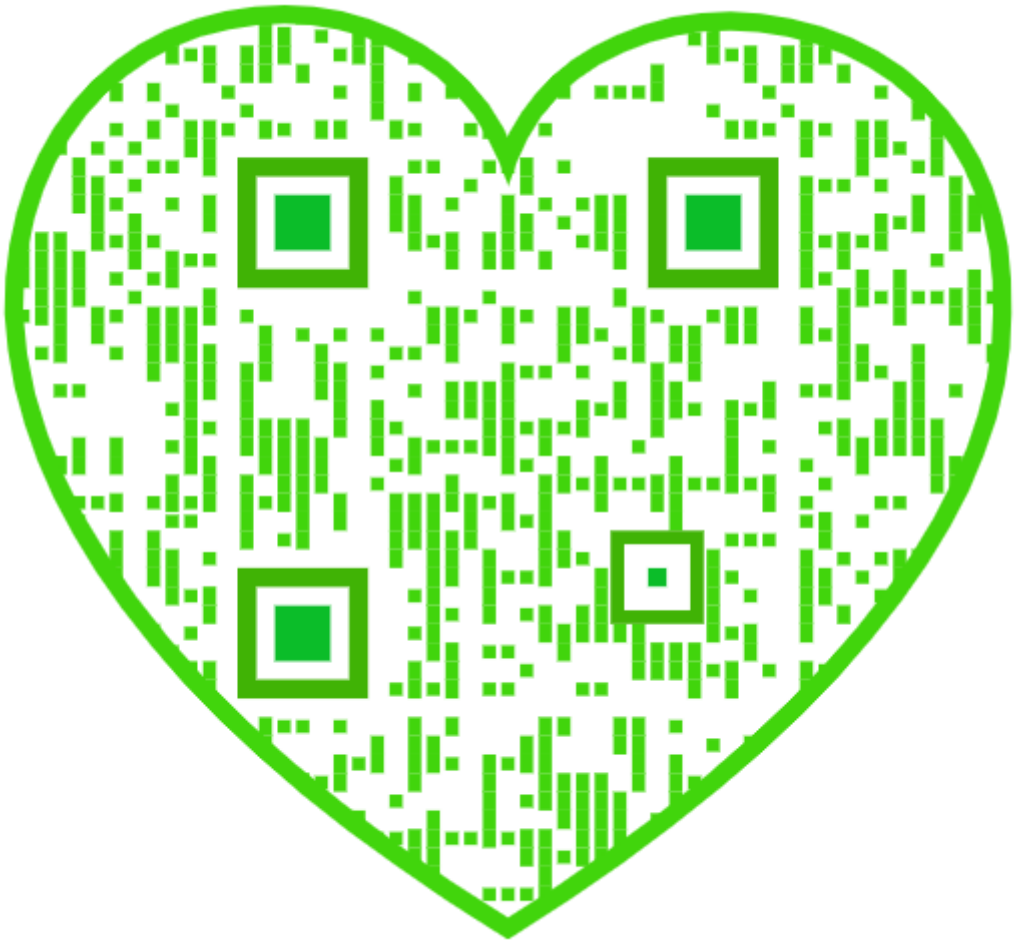

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NEW YORK, SATURDAY, JUNE 8, 1901.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rate.

THE CANADIAN ROUTE FROM THE GREAT LAKES.

At a time when the interests of the Erie Canal seem to be the mere sport of politics, and this greatly needed improvement is apparently as far from realization as ever, it is as well that the people of the State should realize that the Canadian government is pushing forward the interests of the rival route by the way of the St. Lawrence River Canal with the greatest activity. In an address delivered last week to the business men of Montreal, by Mr. Tarte, Minister of Public Works in the Dominion government, he assured them that by the time the improvements of the St. Lawrence were completed Montreal would contain as many grain elevators as the city of Buffalo. He stated that the Port Colborne works, at the Lake Erie end of the Welland Canal, would be completed in two seasons, and that the government was about to undertake important works at Georgian Bay and the French River. The Minister also said that, at the next session of Parliament, he would ask for money to complete a public drydock at Montreal, and that with a view to encouraging a large share of the trade of the Great Lakes to come to that city, he favored a free canal, and a free port at Montreal. Direct evidence of the wisdom of the great St. Lawrence enterprise was shown in the recent sailings of the new vessels of the Northwestern Steamship Company. These ships, the first of which is known as the "Northwestern," have been built specially for the canal route; they are 256 feet in length, 42 feet in beam, 26½ feet in depth and they can carry between 3,200 and 3,500 tons at a speed of 13 knots an hour. On her first trip the "Northwestern" took a large consignment of machines from the McCormick Harvesting Machine Company, Chicago, direct to Hamburg. The vessel cleared Chicago on April 24, and two days later another consignment of 144 carloads of agricultural machinery left for Europe by a sister ship, the "Northman." The fact that vessels are sailing at an interval of only two days, carrying American machinery direct from Chicago to European ports, should bring home to the people of New York State the present reality and the prospective strength of Canadian competition. We have said before, and we repeat it, that the most effective answer to this competition would be the construction of a canal of equal capacity and convenience from Buffalo to the Hudson River; for unless we present some rival water route, New York will see the city of Montreal added to the number of Eastern ports that are taking away the trade which formerly sought its natural shipping point at this port.

HYDRAULIC SYSTEM OF AIR COMPRESSION.

It sometimes happens that an early invention, which anticipated the period of its practical application because of the undeveloped state of the mechanical arts, will, in the course of years, be reinvented, or to speak more correctly, reapplied, with surprisingly favorable results. Of this class is the hydraulic air compressor, which, during the last few years, has been showing results that compare favorably with those attained by other forms of air compressor. The new type traces its ancestry to the venerable trompé, or water-blast, used centuries ago in working the Catalan furnace, in which a moderate air pressure was obtained by means of falling water, the air being drawn in with the water, at the top of a wooden pipe, carried down with the same and collected in a chamber from which it issued to the furnace. The apparatus was crude and the principles but poorly applied; consequently the blast was too weak to be of any service except in the antiquated methods of the middle ages. As the art of iron-making advanced, the steam-driven compressor and the centrifugal blower were developed to meet the demand for a strong air blast; and no one seems to have imagined that the fundamental principles of the old trompé could be developed to meet the demand for great volumes of air at high pressure.

In the Journal of Franklin Institute of September, 1880, J. P. Frizell enunciated the principles of the hydraulic air compressor, and in 1895 it was put into practical form by the patentee, C. H. Taylor, of Montreal, and several installations are now working in various parts of the country with highly economical results. At the Milwaukee meeting of the American Society of Mechanical Engineers W. O. Weber gave the results of a series of tests of the hydraulic compressor at Magog, Quebec, a plant that was fully described and illustrated in the SCIENTIFIC AMERICAN of April 28, 1900. The compressor consists of a downflow pipe which delivers the water and air from a large tank at the top to a separating tank at the bottom of the pipe; the pipe and the lower tank being placed in a deep excavated shaft. A number of small air-inlet pipes lead into the mouth of the downflow pipe, and as the water flows by them, it draws in a proportionate number of jets of air with it. The air is carried down with the falling water and subjected to a pressure proportionate to the head of the water. Within the lower tank is arranged a series of deflecter plates, which decrease the velocity of the water and facilitate the escape of the air; the latter collecting above the water, and being drawn off for use as required. Three series of tests were made, one with thirty-four 2-inch air-inlet pipes, another in which the number of air tubes was increased by fifteen ¾-inch pipes, and a third series of tests in which the number was increased by thirty ¾-inch pipes. The tests were carried out by Prof. C. H. McLeod, of McGill University, Mr. W. O. Weber, of Boston, Mass., the author of the paper above referred to, and others. In the Magog plant the supply penstock is 60 inches in diameter, the downtube 44 inches in diameter; the total depth of the shaft below normal level of head of water is 150 feet and the normal head and fall is about 22 feet. It should be explained that after the separation of the air and water in the lower tank, the surplus water passes out under the edge of the tank, and rising through the shaft escapes by the tailrace. The tests showed that, with the original number of compressor head air-inlets, and a flow of 3,772 cubic feet of water per minute, the pressure of the air at the compressor was 51.9 pounds per square inch, and that the percentage of efficiency of the compressor was 56.8 per cent. When the inlets were increased by thirty ¾-inch pipes the efficiency rose to 64.5. With a flow of water of 4,200 cubic feet per minute, the economy was highest when only fifteen extra air tubes were employed, the efficiency increasing from 60.3 per cent for the original setting to 70.7 per cent as modified. When the flow of water was further increased to 4,600 cubic feet per minute, it was found that there was no economical advantage by increasing the air-inlet area. In addition to the fact that an efficiency of 70.7 per cent was realized under the most economical rate of flow of water, it was proved that the air is compressed at the temperature of the water; a most important result, as the costly cooling plant, necessary with other systems, is thereby dispensed with. Using an old Corliss engine, 81 horse power was recovered; a result which would represent a total efficiency of work, recovered from the falling water, of 52.2 per cent. In a test in which the compressed air was preheated to 267 deg. F. before being used in the engine, 111 horse power was recovered when using 115 pounds of coke per hour, which latter, it was estimated, would equal about 25 horse power. The efficiency of work recovered from the falling water and the fuel burned would, therefore, be about 61½ per cent. On the basis of 425 cubic feet of air per brake horsepower per hour, when preheated to 300 deg. F. and used in a hot-air jacketed cylinder, it is estimated by the author of the paper that the total efficiency secured would have been about 87½ per cent.

COMPARATIVE EFFICIENCY OF KRUPP AND OTHER HIGH-POWER GUNS.

It seems that our comments upon an article published in the German scientific journal Prometheus on the comparative efficiency of the Krupp, Armstrong and Schneider-Canet guns have been misunderstood by some of our readers. A recent issue of our German contemporary states that, in our criticism, the efficiency of the German gun is "acknowledged in very appreciative words," and Prometheus is correct in stating that it is our opinion that the "superiority of the German gun results from the great weight of the projectile used;" but when it proceeds to credit us with the statement that heavy projectiles are not always the best, and that it is "doubtful whether the Krupp gun will still show so enormous an efficiency if fired with the lighter projectiles used in England and France," it is in error and must be confusing the opinions of the SCIENTIFIC AMERICAN with Continental criticisms which "have been re-echoed by the English press and apparently accepted with a certain satisfaction," As a matter of fact, we did not touch upon the question of the efficiency of the gun under other conditions than those for which it was designed. What we did say was that the greater weight of the shell will reduce the total number of rounds that can be carried for each gun; a consideration which is of the greatest importance, where every ton of displacement of a ship is valuable, when it comes to the question of distribution among the contending claims of armor, engines, stores and ammunition. We said furthermore that the increased weight must tell somewhat against the rapidity of handling, and that if the ammunition is to be handled at the same speed, it becomes necessary to install heavier machinery for operating the hoists.

As a matter of fact, we consider that the German artillerists have shown considerable shrewdness in increasing the weight of their projectiles and thereby securing greater effectiveness at long ranges. The wisdom of this policy will be seen, we think, whenever the next naval campaign shall be fought; for we entirely agree with our contemporary in the prediction that there will be a tendency to carry out naval engagements of the future at ever-increasing ranges, and this because of conditions similar to those which have so vastly increased the fighting range on land in recent wars. It is likely that the battle of the future will begin at unusually long ranges which will gradually decrease as the engagement proceeds, the ships approaching each other as the battle reaches the decisive step.

It is evident from the comments of Prometheus that some of its European contemporaries have been questioning the suitability of the Krupp gun to fire lighter projectiles at higher velocities; probably assuming that the Krupp gun is unable to withstand the higher pressures that will be necessary. In reply to this Prometheus gives some graphical comparisons of the 12-inch and 6-inch guns of the Krupp, Vickers and Armstrong makes, which show that when the same weight of shell is used in each, the highest ballistic results are still achieved by the Krupp weapons. Thus, for instance, in a comparison of the 12-inch 40-caliber gun, it is shown that the Krupp weapon has an initial velocity of 816 meters, as against 791 and 786 meters, respectively, for the Vickers and Armstrong guns, the equivalent muzzle energies being 13,100 meter-tons for Krupp, 12,340 meter-tons for Vickers, and 12,515 meter-tons for Armstrong. At a range of 3,000 meters the remaining velocities and energies are as follows: Krupp, 681 meters and 9,110 meter-tons; Vickers, 659 meters and 8,540 meter-tons; and Armstrong, 655 meters and 8,440 meter-tons. Although these results are very gratifying as compared with other European weapons, it is satisfactory to note that they are surpassed by the new United States naval 12-inch gun, which with a muzzle velocity of 870 meters has developed a muzzle energy of 14,865 meter-tons, or 1,765 meter-tons more than the Krupp gun. The remaining velocities and energies at the various ranges are, of course, proportionately greater than those of the latter gun. At the same time, it is but just to point out that, judged on the basis of energy per weight of gun, the Krupp weapon is superior; our new gun showing 272 meter-kilogrammes per kilogramme of weight of gun, whereas the German weapon shows 288 meter-kilogrammes. Prometheus points out that the light weight of the German weapons compared with their high efficiency argues particularly excellent quality both in gun steel and the construction of the gun itself; a point which is certainly well made.

GROWTH OF THE TINFOIL INDUSTRY.

Recent ornamental novelties made of pure tinfoil, lacquered with gold and embossed in various forms, manufactured for the drug, confectioners' and tobacconists' trades, serve to call attention to an invention and industry that are purely of American origin and growth. Before the inventor of tinfoil hit upon the idea of rolling tin upon sheets of lead, the two metals being previously welded together, the only tinfoil known to the world was that of pure tin beaten by a process similar to that followed by gold-leaf beaters. This beaten tin was made in England, and only small quantities were imported into this country. Its use was limited because of its expense and its liability to tear.

The first tinfoil rolling mill was established in New York city about half a century ago, and it was started on such a modest scale that the rollers were obtained as second-hand iron. The English-beaten tinfoil was found to be so expensive in this country that a cheaper method of making it was tried, and proved successful. The business of this early, but now extinct, tinfoil factory was thus announced: "Foil Rolling Mill and Metallic Cap Works; tobacconists' foil, plain or embossed, tin sheet-foil for druggists and bottlers, superior to the imported article."

In the half century which has followed this modest beginning of an industry great strides have been

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made in manufacturing tinfoil and in applying it to manifold commercial uses. New machines have been made to work it up into handsome ornamental forms, and considerable capital has been invested to extend its usefulness. There is very little export trade in tinfoil, as the foil is also made extensively in England, France and Germany, but the home trade is adequately supplied by the four tinfoil factories in this country—two in New York, one in Philadelphia, and another in St. Louis. After the expiration of the original patents these four factories started almost simultaneously, and they have controlled the output of the material ever since.

New machinery and processes for improving the tinfoil are being invented nearly every year, and the quality of the material produced to-day is infinitely better than that of a dozen years ago. A good deal of the new machinery is made to enhance the ornamental effects of the foil, but not a little of it is made to increase the strength and wearing quality of the material. In the druggist and confectionery trades the demand for very highly ornamental tinfoil effects is especially urgent, and artists of considerable ability are engaged to produce fancy patterns. The silvery surface of the tinfoil is made more effective by fancy patterns of stars, figures and fine lines, which are stamped or embossed in the sheets by special machinery. Recently machinery was made to print the patterns on the sheets of foil in colors. In order to do this the sheets of foil are put through regular printing cylinder presses, which not only color the patterns but stamp in the "dead" effects of various figures and lines. The machinery required for this delicate work is quite elaborate and represents part of the invested capital of the plant.

The tinfoil is also lacquered handsomely with gold, which, in connection with the embossing and printing in colors, produces remarkably artistic effects. Many large firms employ these fancy effects as trade marks which are stamped or printed on all the foil they use as wrapping for their articles. Tinfoil is growing rapidly in use for wrapping purposes where food and other articles must be kept from the air as much as possible. Its first use was for tobacco wrapping, and the demand in this trade stands first to-day. Fine cigars, plug tobacco and cigarettes have the fine aroma of the tobacco and the natural moisture retained indefinitely by this process. Most prepared foods are wrapped in tinfoil, and now that the manufacture of these has grown tremendously the demand for tinfoil has increased also to remarkable proportions. Cheese, yeast cakes, and other products of the delicatessen order require annually tons of pure tinfoil. Confectioners have also resorted to the use of tinfoil for wrapping their choice candies in preference to tissue paper. The drug trade has found infinite uses for the foil because of its air-tight qualities, which keep the goods from direct contact with the atmosphere.

Perishable goods shipped to warm, tropical countries are frequently wrapped in tinfoil to exclude the air and to retain the natural moisture. A combination of thin paper and tinfoil is considered better for food products than the foil alone. It was considered better not to have the foil come in direct contact with the food, and consequently a machine was made by which the sheets of tinfoil and paper were firmly adhered together. These double sheets are used so that the paper alone comes in contact with the food, while the tin serves all the purposes of excluding the air. There is considerable labor of folding saved by this process, and only one instead of two foldings is required for each separate article.

Some foil is brought into direct contact with certain classes of food, which by its nature could not well absorb any poison from the foil, but the factories make all such foil wrapping from pure rolled tin. There is no lead mixed with this foil to give occasion for reports of poisoning from goods wrapped in tinfoil. This foil is more expensive to make, and the combination of tinfoil and thin paper is becoming more popular.

Bottle caps are manufactured largely out of tinfoil, but they are of a different quality and manufacture from that of the ordinary foil. The sheets for this work are spun on a lathe from a mixture of lead and tin. There is more lead in this foil than in the finer quality for general use. The foil is thicker and coarser, and as it never comes in contact with the contents of the bottle the amount of lead in it is immaterial from the consumer's point of view. The thickness of the tinfoil in common use runs from one-half of one-thousandth of an inch up to almost any thickness required by special trades. The thinner the foil is rolled or spun the more expensive it is. The foil is rolled usually in sheets fifty feet in length and in varying widths. Some machines are made to roll it twelve inches wide, but most of them have only half this width, as trade demands favor the narrower widths After the sheets are rolled they are stamped, printed, and embossed in suitable sizes and patterns, and then cut up in lengths desired. Millions of pounds are required for the trade in this country, and the market price runs from 75 cents per pound for the handsome embossed and lacquered foil down to a few cents a pound for the cheaper grades. G. E. W.

METHODS PROPOSED FOR DEALING WITH LONDON'S CONGESTED TRAFFIC.

Elaborate projects are being framed by the London County Council for dealing with the crowded thoroughfares of the English metropolis, and to inaugurate a system of intercommunication similar to that already existent in the most modern cities. The tramways are to be immediately converted to electric roads; the river is to be supplied with an efficient and rapid service of steamers; while it is also mooted that an attempt is to be made to relieve the congested condition of the Strand and Fleet Street by the construction of street subways similar to those of Boston.

With regard to the tramway systems, for some time past the County Council have been carrying out experiments to determine what method of supplying the current to the car motors is best adapted to the exigencies of the case. It has been decided to employ both the overhead trolley and the conduit systems, the former to be more generally employed in the less crowded thoroughfares of the suburbs. At the present time there are 115 miles of street tramways in London, and the carrying capacity averages 350,000,000 passengers per annum. With the present system of horse traction a profit of $1,250,000 is earned annually. If electric traction were employed it is computed that this profit would be increased to $3,300,000. A comprehensive idea of the earning capacity of the tramways may be realized from the first year's working by the County Council of the tramways south of the Thames. This service was purchased by the municipal authorities for $4,375,000, and the surplus upon the year's working amounted to $65,000. The mileage in this instance is 24 miles, with an earning capacity of $7,835.

One of the most perplexing difficulties with which the Council have had to contend in connection with their proposed inauguration of electric traction is the fact that the roads in the various districts through which the tramways extend are controlled by the local authorities, the majority of which are bitterly opposed to the change. There are no less than fifty of these small local authorities possessing the power of veto over the roads. The objections in many instances have been successfully surmounted, but negotiations are still being carried on with those authorities who remain obdurate, and it is anticipated that the installation of the electric plant will be commenced almost immediately.

With regard to the river traffic the Council considers that the development of a fast and frequent service upon the waterway is an efficient means of relieving the streets. The service at present in vogue is distinctly inadequate, and is only for summer use. The boats are slow and antiquated, and the service too infrequent to commend its more widespread utilization. According to the scheme of the Council, it is intended to supply a three minutes' service; to provide a fleet of fast, comfortable, and modern river steamers; and, if possible, to secure the entire control of the river piers, which at present are under the auspices of the Thames Conservancy. The enterprise will cost $2,500,000 to carry through. The boats will cost $37,500 each. The piers will be transferred from the sides of the river to the center round the pillars of the various bridges, approaches to which will be provided. It is estimated that the cost of maintaining the service will amount to $700,000 per annum.

The suggestion of supplying underground tramways to the principal arteries of traffic, though generally favored, is beset with innumerable difficulties. For the most part, the streets of London are intersected in all directions by electric cables, gas, water, and pneumatic pipes, etc. Under these circumstances if such a tramway were constructed it would have to be at a great depth, which would have the effect of preventing its being used for the very purpose for which it was intended. If the descent of about a dozen steps from the street level were only necessary to give access to the subway, then it would doubtless prove a great success. To insure this, the network of obstructions would have to be removed, and this could only be accomplished at a great outlay. The general idea is to lay all pipes and wires in a long tunnel, running parallel to the tramway, so that access could easily be gained thereto for carrying out repairs, or for the laying of new material, without disturbing the surface of the street, and causing great inconvenience to the vehicular traffic. At the present time the principal thoroughfares in the metropolis are up for the laying of the government telephone cables, which are to extend over a mileage of 640 miles, causing widespread inconvenience. Many of the streets of London are provided with a duplicate thoroughfare below, in which are the gas, water, and other pipes, wires, etc., but the idea is not general throughout the city. The Council are carefully studying this scheme, and since the chairman of the Highways Committee, who have the subject in hand, has investigated the system in vogue in Boston, and is convinced of its practicability in London, there appears every symptom of its adaptation to the English metropolis within the near future.

The Central London Electric Railway has had the effect of considerably relieving the congestion of the streets, and has proved such a success that application is to be sought for Parliamentary powers to extend the railway at the city terminus at the Bank to Liverpool Street, the terminus of the Great Eastern Railroad, and which supplies the densely populated districts of Walthamstow, Stratford, Bow, Stepney, etc.; and also at the southern terminus at Shepherd's Bush. It is also stated that another similar railway is projected by an American syndicate to connect Victoria with Putney, a remote southwestern suburb.

WIRELESS TELEGRAPHY FOR THE PREVENTION OF SHIPPING DISASTERS.

For some time past numerous experiments have been carried out with Marconi's wireless telegraphy with a view to employing the system on lighthouses, etc., as a means of preventing maritime disasters. But the endeavors have only been attended with such mediocre success that it has not been considered advisable to develop the matter. But a novel device has now been invented by Mr. J. Gardner, of Manchester (England), which, so far as the present experiments are concerned, has been highly successful. It is termed an automatic signaler, from which it will be gathered that its mechanism is automatic in its action. The inventor claims that by this means an adequate warning is supplied to vessels of impending danger, within a zone, the radius of which has been previously determined. It may be either applied from ship to shore, or from ship to ship while at sea, with equal success and reliability.

The apparatus is somewhat similar to that utilized by Marconi. At the shore station a mast is set up, to the top of which is attached a metallic conductor. This conductor is connected to the transmitting apparatus, which is accommodated in a building in close proximity. The transmitter consists of an induction coil, and the accumulators for the provision of the current. The automatic portion of the instrument consists of a specially cut wheel, bearing the name of the danger spot to which the mast is attached. This wheel controls a Morse key. This wheel is maintained in constant rotation, the periphery being regulated to any desired time, so that one revolution may be completed in one, two, three or more minutes.

Vessels are supplied with a receiver, and directly a ship enters the danger zone the instruments print off on the tape machine in the Morse code the name of the danger spot it is approaching, at the same time setting a bell in motion; both bell and receiver continuing to operate until the ship has once more passed beyond the influence of the transmitting apparatus. All vessels that happen to enter the danger zone receive the warning simultaneously, as with Marconi's system the apparatus is not affected by any climatic conditions.

The preliminary experiments for demonstrating the efficacy of the scheme were conducted at the mouth of the Thames. The shore station was established at Shoeburyness. A steam launch put off from Southend provided with a receiving instrument, the invention of Colonel Hozier—the secretary to Lloyd's—and Mr. Nevill Maskelyne. A stiff breeze was blowing and a thick fog hung over the water. The launch stood about eight miles out to sea, and then the automatic apparatus at the shore station was set in motion, the zone of influence in this instance extending to seven miles. The launch then put about and wended her way shoreward. Suddenly the bell commenced ringing violently, and simultaneously the word "Southend," the name of the danger spot, was printed upon the tape machine. The vessel then put out to sea again, and entered the zone from another quarter, but the moment it entered the range of influence of the shore station the warning was received. For two hours these trials were continued, but with always the same result. The instrument never once failed in its working, thus conclusively testifying to its efficiency and reliability.

There were several well-known shipping men present at the trials, including the representatives of the Cunard, White Star, the American, the P. & O., and other leading steamship lines, and the secretary of Trinity House. In connection with its adaptation for vessels the receivers on two respective ships approaching one another would receive the name and course of the other. In view of the practicability of this automatic signaler and the possibility of reducing the number of maritime disasters by its utilization, the installation of the apparatus at several points of the British coast within the near future is probable.

The American losses of troops in the Philippines since August 6, 1898, are as follows, says The Medical Record: Killed, 741; died of wounds or accidents, 472; died of disease, 2,295; total deaths, 3,508; wounded, 2,638; grand total, 6,146.

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COPPER MINING IN AMERICA.

BY WALDON FAWCETT.

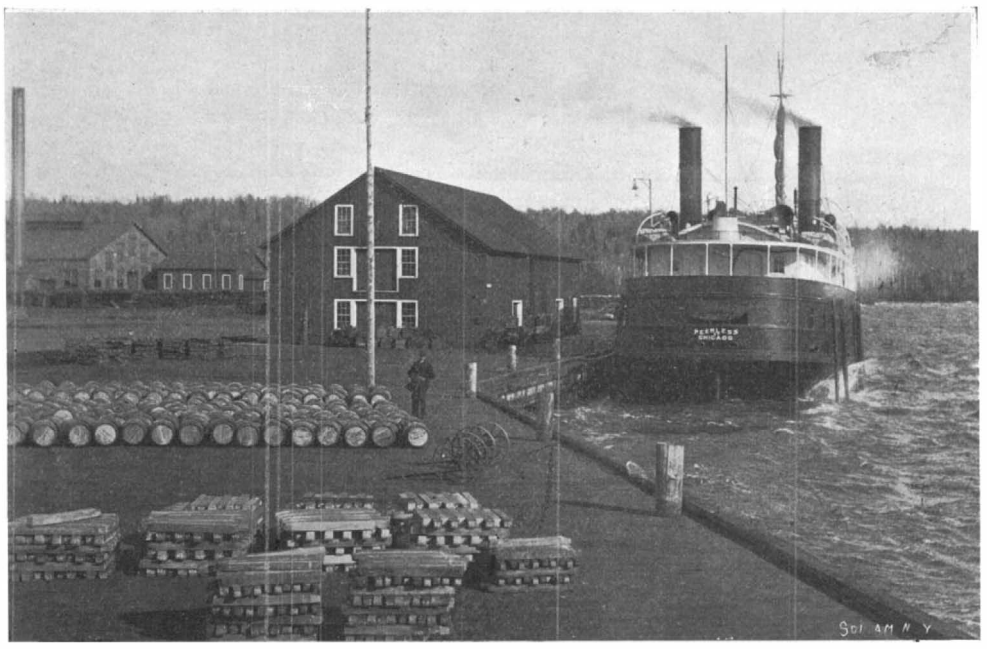
No phase of the development of the natural resources of the United States has been characterized by more rapid or more really remarkable progress than the growth of the copper industry. For one thing, this commodity holds the unparalleled record of having shown, even in the face of financial panics and business depression, an increase of production during practically every year since the inauguration of operations, until now the annual output of the metal is worth approximately $100,000,000, or considerably more than all the gold produced in this country during an equal interval. Perhaps even more impressive is the fact that the United States has within little more than a half century risen to the position of mining more copper than all the rest of the world combined, and in so doing has virtually established control over the markets of the globe.

Copper is produced in the United States principally in Arizona, California, Colorado, Michigan, Montana and Utah, although various other divisions of the Union, particularly the Eastern and Southern States, make contributions to the aggregate output. During the past two decades, however, the center of production has moved westward. In 1845, the year which marks the commencement of modern copper mining on this side of the Atlantic, the total production of the United States was estimated at one hundred tons, of which Michigan yielded a dozen tons. From that time forward the ascendency of the Lake Superior copper district over other sections became more and more pronounced. In 1856 Michigan miners took from the ground over nine-tenths of all the copper secured in the country, and as late as 1880 the Michigan output constituted more than four-fifths of the total production.

Then came the development of nature's great storehouse of copper in Montana, and although the record of growth was fully as meteoric as had been the career of the Lake Superior territory, it was not until 1892 that Montana finally displaced Michigan as the greatest copper-producing State. The same relative positions have been maintained ever since. On a rough estimate, Montana furnishes, at the present time, about 40 per cent and the Lake Superior mines perhaps a quarter of the American production of copper. Arizona, wherein is located the most recently discovered of the three great copper fields, ranks next to Michigan, her copper-mining operations footing up about one-fifth of the grand total. It is interesting, if not significant, to note that Arizona showed the greatest gains in production recorded during the closing year of the century, whereas Montana showed but a slight increase and the Lake Superior district barely held its own.

The expansion of the scope of the copper-mining industry has been attended by an improvement of methods and facilities fully as great as, if not greater than, has been afforded in any other branch of mining operations. To appreciate the extent of the betterment it is only necessary to compare the economical and efficient mining systems and reduction plants in use to-day with the primitive methods of half a century ago, when much of the copper was taken from the rock by means of drills and gads. The introduction of black powder for blasting purposes was a long step ahead and opened the way for other innovations.

Under the present plan, new shafts are sunk with incredible rapidity. Diamond drills are extensively employed in making explorations, and power rock drills are in almost universal use in mining operations proper. Instead of being dependent upon oxen, hoisting buckets of rock by means of a windlass, as in the old days, the modern copper mine is equipped with hoisting engines of from five thousand to eight thousand horse power, which hoist ten-ton cars of rock from a depth of nearly a mile at a speed of 55 miles an hour.



COPPER, READY FOR SHIPMENT, LAKE SUPERIOR DISTRICT.

Originally the copper mine operators introduced gravity stamp mills, but these proved totally inadequate, and latterly steam stamps have been provided, of such power in some instances that an average of 350 tons of ore can be crushed daily at a single mill. The equipment of a large modern copper mine also includes powerful air compressors, capable of supplying perhaps fifty air drills, and fans thirty feet in diameter with a capacity of one hundred thousand cubic feet of air a minute for underground ventilation.

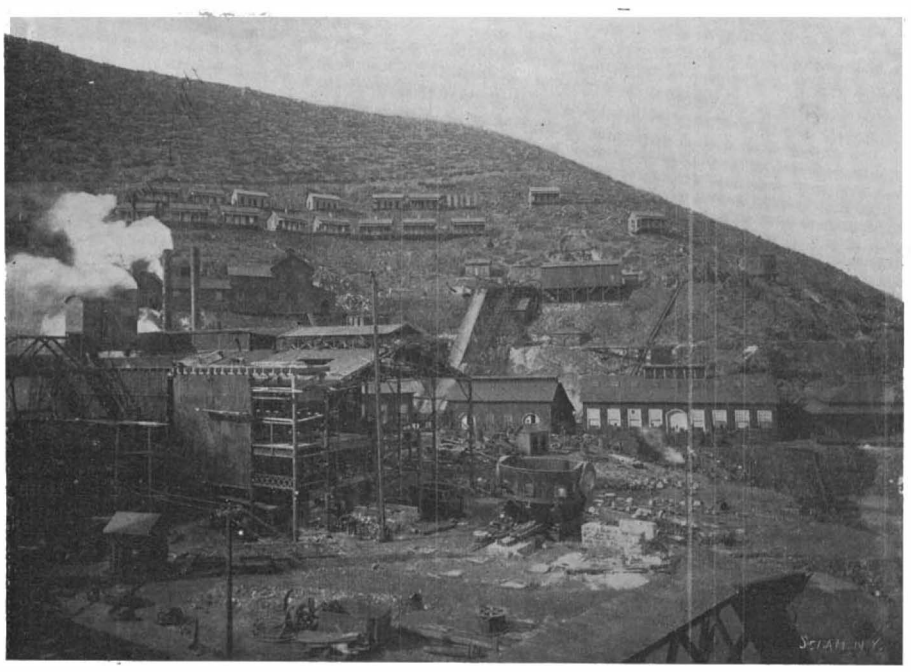
Some of the older copper mines in the United States rank among the deepest holes in the world. The Red Jacket shaft in the Lake Superior district, for instance, an opening about twelve feet by twenty-five feet in size, has been sunk vertically to a depth of nearly five thousand feet, and is claimed to be the largest and deepest shaft of its class in the world. Branching from the main shaft are innumerable "crosscut" tunnels through which the copper ore is carried to the main artery of communication and hoisted to the surface in ten-ton cages, each of which makes half a dozen round trips in an hour, enabling the hoisting of more than five thousand tons of ore from this one mine every working day in the year.

The average cost of producing a pound of copper does not greatly exceed eight cents, and at the prices which have prevailed for many months past some of the operating companies have made a clear profit of from nine to eleven cents on every pound produced. If the copper taken from the ground in America during an average year is estimated to be worth $100,000,000, it is safe to credit $50,000,000 as net profit. How rapid has been the growth of the industry is attested by the fact that a year's profits under present conditions more than equal the total value of the American product for a corresponding interval half a decade ago. The great improvement in prices and market conditions of late years may be largely attributed to the growing foreign demand. Europe consumes an enormous quantity of copper, and for a heavy proportion of it she must depend upon the United States.

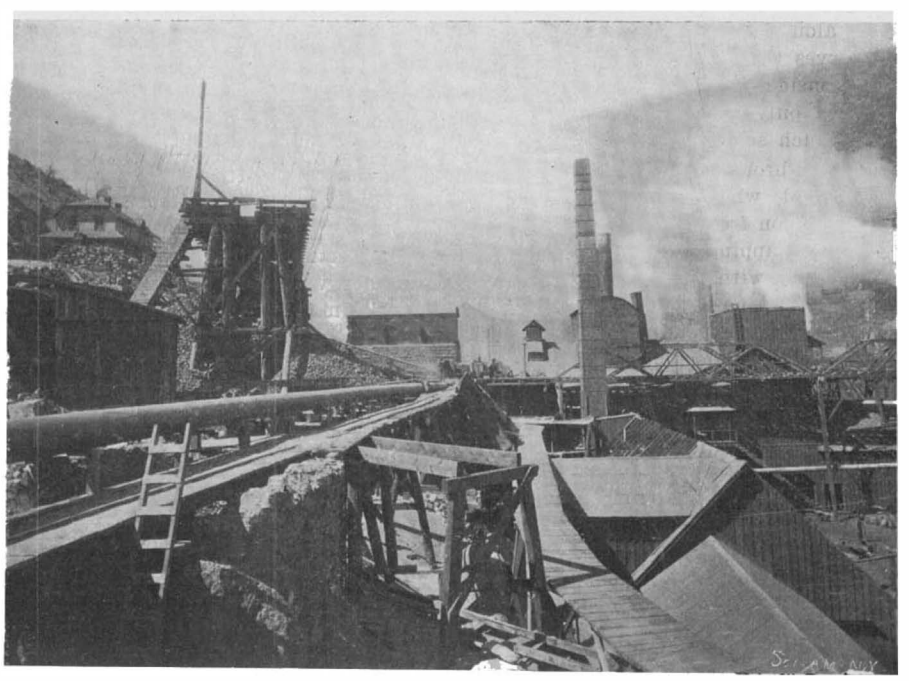
One of the most interesting copper mines in the world is the United Verde, at Jerome, Ariz., of which Senator W. A. Clark, of Montana, is the principal owner. The smelting plant is one of the largest in existence, consisting of six water-jacket furnaces, each of which has a capacity of 160 tons of ore a day. The metal is transferred by electric cranes from the furnaces to the converters. There are six of the latter, and they have a daily capacity of 1,200 tons. A curious process which the molten metal must undergo after it has been poured from the converter into the broad, shallow, tilting furnace is found in the placing of green cypress poles in the caldron to afford a chemical antidote for a certain existent acid condition. The bullion copper is cast in the form of "anodes"—slabs about three feet in length, with a hook at one end which facilitates the suspension of the piece of copper in the electrolytic bath in which it is submerged when it reaches the refinery. The machinery installation at the United Verde smelting plant is reported to represent an expenditure of over $1,000,000. Thus far the mining shaft at the United Verde property has pierced the ore body to a depth of only about 600 feet, but exploration by diamond drill has disclosed the fact that there is rich ore to a depth of 1,400 feet farther. The ore body varies considerably in width, but is not less than 600 feet in breadth at any depth yet reached in the development.

The great demand for copper is doubtless responsible for the fact that in no other branch of metallurgy has a higher degree of scientific attainment been reached than in the treatment of copper-bearing ores. Improvements are constantly being introduced at every stage in the evolution of the metal. It is interesting also to note that practically every nationality on the globe is represented among the artisans of the copper industry. At Calumet, Mich., the center of the Calumet and Hecla Company's interests, and the largest mining camp in the world, the population includes natives of twenty-three different countries. The Calumet and Hecla Company employs five thousand men, of whom two thousand are miners. The latter receive from $2.10 to $2.65 a day; the drillers are paid from $3 to $4 a day, and the pay of the captains of mines or shafts is at the rate of $5 or $6 a day. Some of the most highly skilled workmen receive nearly $10 a day.

One of the dangers which ever threatens copper mines is found in the havoc wrought by disastrous



COPPER MINE WORKINGS AT JEROME, ARIZONA.



CLARK'S COPPER MINES, JEROME, ARIZONA.

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fires, and every precaution is taken to guard against these conflagrations. At most of the older workings, as well as at the new mines, there are complete systems of fire alarms, fire doors, and pipe lines; the employes are organized into thoroughly drilled companies of firemen; and steam fire engines and duplex fire pumps are provided. Supplementary to the regular alarm apparatus, connection between all the various workings of a mine is maintained by means of a system of electric bells and private telephones. That all possible precautions have not made the natural storehouses of copper invulnerable, however, is evidenced by the fact that some time ago one of the shafts of the Calumet and Hecla mine caught fire and burned fiercely for weeks, entailing a loss of $15,000 a day, and this in spite of the fact that this mine has a private water works system which daily pumps two million gallons of water a distance of nearly five miles.

ELECTRIC AUTOMOBILE—KRIEGER SYSTEM.

One of the latest types of electric automobiles is the new two-place machine of the Krieger type, or "electrolette," as it is called. This is the smallest machine of this type which has been designed up to the present. In this system the front wheels turn at the end of a fixed shaft, and each is driven by a separate motor with reduction gearing, thus doing away with the differential and making a less complicated arrangement. This machine has been designed to meet the demands for a light electric automobile and to overcome the objection that an electromobile must necessarily be heavy, on account of the weight of the accumulators, as well as costly. It has thus been necessary to design a vehicle which should be free from these objections; it should be light and easily operated, and should not require more than ordinary attention from its owner. It must also cover a considerable distance without recharging, in spite of the light weight of the vehicle, and its average speed should be somewhere near that of a petroleum automobile. M. Krieger, owing to his previous experience in this direction, has succeeded in solving the problem of a light electric vehicle, and the present machine is the result. As will be seen, it is a two-place vehicle, but as the carriage body is made removable, a four-place body may be substituted, in spite of the small size of the machine. The front axle, which is fixed, is carried well in front, and at each end the wheel turns like that of an ordinary carriage. The fixed axle supports near the wheel an electric motor of 3 horse power, which is of the latest design and entirely inclosed by its circular casting and end-pieces. The pinion comes out at the side next the wheel and engages with a large gear wheel which is fixed against it. The gear and pinion are inclosed in a tight case. Thus each wheel is turned independently by its own motor, and the result is a great gain in simplicity, owing to the suppression of the differential; it is this system which has made the Krieger type one of the most successful of the electric automobiles. The truck is supported upon the front shaft by a curved spring. The whole system turns about a central pin, and is steered by the hand-wheel above, by means of a pinion and toothed sector. The accumulators are contained in a box which is fixed in the truck below the carriage body and is arranged so that it may be easily slid out from the rear. The batteries are of the Fulmen type, and have a total weight of 800 pounds, allowing a run of at least 65 miles on a single charge. The two motors, each of 3 horse power, give a total of 6 horse power for the machine, which enables it to climb heavy grades without injuring the motors. The latter are arranged so as to be accessible from above, which renders their inspection and cleaning much easier than in the ordinary type of electric vehicle. The total weight of the machine, in spite of the 800 pounds of accumulators, is only 1,700 pounds, of which the motors represent 220 pounds. The mean speed on a level grade is 21 miles an hour, or 12 to 15 miles over an average road. The controller of the Krieger type has the advantage that

THE KRIEGER ELECTRICAL AUTOMOBILE.

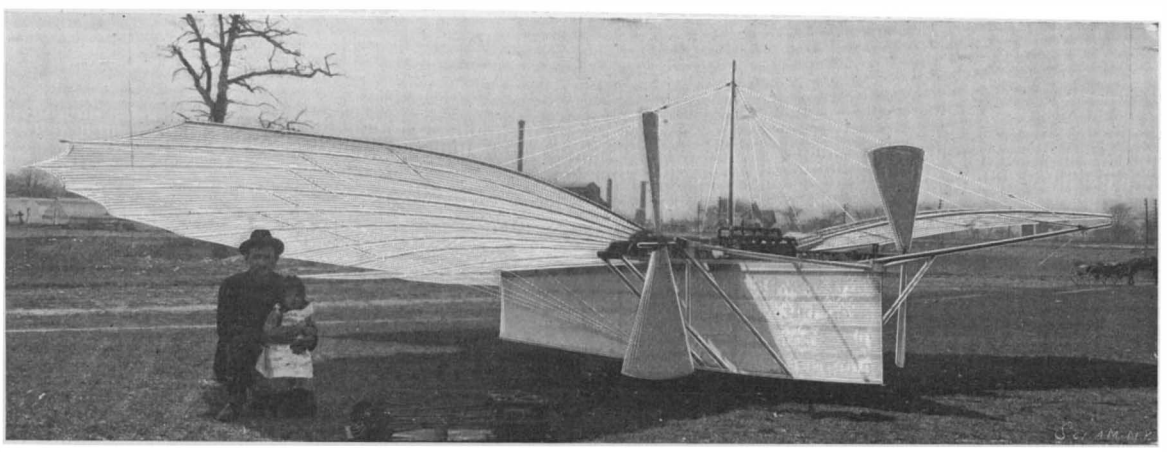
the steering wheel and controller are mounted in a single device and the whole direction of the machine is brought to one point. The shaft of the steering wheel passes down through the carriage body, while surrounding it is a hollow shaft upon which is mounted the controller drum. The latter is turned about the main shaft by a handle directly under the steering wheel. The controller is formed of an insulating cylinder carrying a series of contact rings which rub against the contact spring-pieces at the side of the box. The controller may take 11 different positions, including start, slow, mean and high speeds, an extra speed, electric brake and reverse. The electric braking action is carried out by placing the motors in short circuit, thus giving a powerful brake upon the front wheels; besides this, the rear wheels carry a band-brake.

A NEW FLYING MACHINE.

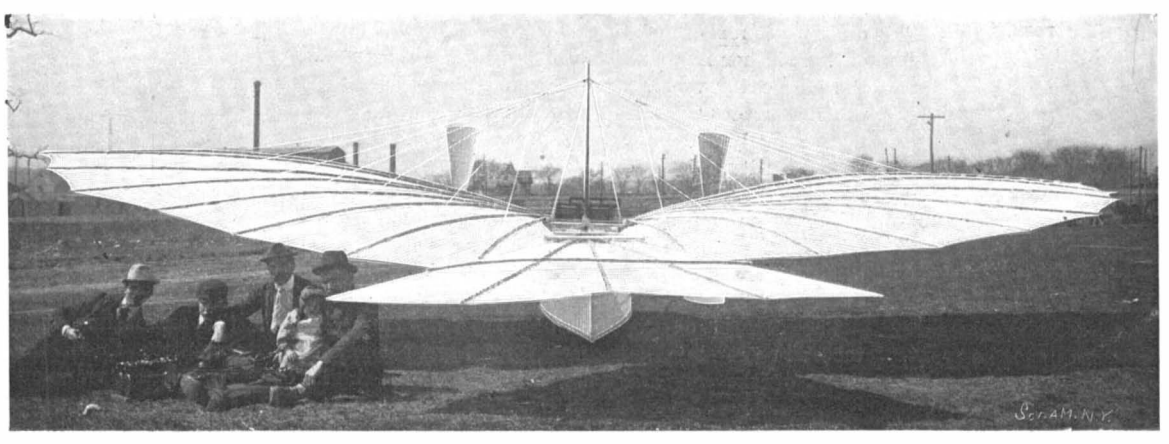
A novel flying machine has just been completed by Mr. Gustave Whitehead, of Bridgeport, Conn., and is now ready for the preliminary trials. Several experiments have been made, but as yet no free flights have been attempted. The machine is built after the model of a bird or bat. The body is 16 feet long and measures 2½ feet at its greatest width and is 3 feet deep. It is well stayed with wooden ribs and braced with steel wires and covered with canvas which is tightly stretched over the frame. Four wheels, each one foot in diameter, support it while it stands on the ground. The front wheels are connected to a 10 horse power engine to get up speed on the ground, and the rear wheels are mounted like casters so that they can be steered by the aeronaut. On either side of the body are large aeroplanes, covered with silk and concave on the underside, which give the machine the appearance of a bird in flight. The ribs are bamboo poles, and are braced with steel wires. The wings are so arranged that they can be folded up. The 10-foot rudder, which corresponds to the tail of a bird, can also be folded up and can be moved up and down, so as to steer the machine on its horizontal course. A mast and bowsprit serve to hold all the parts in their proper relation.

In front of the wings and across the body is a double compound engine of 20 horse power, which drives a pair of propellers in opposite directions, the idea being to run the machine on the ground by means of the lower engine until it has the necessary speed to rise from the ground. Then the upper engine actuates the propellers so as to cause the machine to progress through the air to make it rise on its aeroplanes. The wings are immovable and resemble the outstretched wings of a soaring bird. The steering will be done by running one propeller faster than the other in a way analogous to the way in which an ocean steamer having twin screws can be turned, a special aeroplane being provided to maintain longitudinal and transverse stability.

The lower engine is of 10 horse power, and weighs 22 pounds. The diameter of the cylinder is 3 7-16 inches by 8 inches stroke. The upper engine is a double compound cylinder, the diameters being 2¼ and 3 7-16 inches with a 7-inch stroke. The engine weighs 35 pounds, and calcium carbide is used to develop pressure by means of explosions. The propellers weigh 12 pounds, and are 6 feet in diameter, with a projected blade surface of 4 square feet. With a draw-bar test, the upper engine being run at full speed, the dead pull was 365 pounds. The weight of the body and wheels is 45 pounds. The wings and tail have 450 square feet of supporting surface, and the weight is 35 pounds.



WHITEHEAD'S FLYING MACHINE, SHOWING ENGINE AND PROPELLERS.



WHITEHEAD'S FLYING MACHINE, SHOWING AEROPLANES.

Messrs. William Jessop, the famous steel manufacturers of Sheffield (England), are about to establish extensive steel works in this country. This decision has been caused by the American Steel Combine and the high prohibitive tariffs imposed upon foreign steel. Messrs. Jessop have a large business connection on this side, and by the establishment of local works, owing to fuel being cheaper, they intend to force the market, and thus to oppose the Steel Trust. The proposal has excited the greatest interest in the steel circles of Sheffield, and other manufacturers who also have an American connection contemplate a similar step. The enterprise is being substantially supported financially. Already several English manufacturing firms have established works in foreign countries protected by heavy tariffs. Notably is this the case with Russia, and the enterprise has been attended with signal success.

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Correspondence.

A Suggestion from the Philippines.

To the Editor of the SCIENTIFIC AMERICAN:

Your issue of February 23 speaks of the closing year of the nineteenth century being remarkable for inventions and the inventive ability displayed. I want your paper to bring before the public and inventors, and even the United States government, the urgent necessity for a machine that will separate the pulp from the hemp fiber. I give you a few statistics to show the immense importance to the States and the world of such a machine. The exports of hemp from the Philippine Islands in the following years were: 1895, 1,664,590 piculs (a picul being here 137 pounds), valued at $13,317,700, Mexican; 1896, 1,531,786 piculs, valued at $11,200,000, Mexican; 1897, 1,804,756 piculs, valued at $13,340,000, Mexican; 1898, 1,585,212 piculs, valued at $15,587,316, Mexican; 1899, 1,201,476 piculs, valued at $7,589,600, making a total for five years of 7,787,820 piculs, valued at $61,033,916, Mexican. All this hemp was cleaned by a crude hand method, which is simply placing a bolo or strong blade 18 inches long parallel with a piece of wood or bamboo, sharp side down, and drawing a piece of the male banana plant through it. One good man can clean about forty pounds a day. This product then has to be dried in the sun, so that the hemp grower is playing against blind luck right through. With a good hemp-cleaning machine would come naturally a drying machine of the centrifugal type, and with economical methods of cleaning and drying would come greater production and a cheaper dressed article, namely, a good rope, and this would be an economic factor in many other industries. The man who invents this machine will make a large fortune rapidly, as well as enrich the islands and the States. Inventions of this kind will be industrial factors in the islands, and consequently will make for peace and prosperity. Let the United States government offer a prize of, say, $25,000 gold for the required machine. It will pay the country handsomely and better than treating with or buying gugus.

FRANK J. DUNLEAVY.

Battobato, Island Mindanao, P. I., April 18, 1901.

Automobile News.

Consul-General Guenther, of Frankfort, March 22, 1901, says that a Berlin engineer has constructed a trolley automobile line similar to that exhibited at the Paris Exposition, at Eberswalde, a small city near the German capital. In this system, continues the consul-general, the automobile receives its motive power from an overhead wire by means of a trolley, which is connected with the automobile by a movable cable. This allows the vehicle to turn out at any place on the road. The consul-general adds that the line has been favorably inspected by experts, and that the system is expected to meet with general favor in Germany.

The Count de Chasseloup-Laubat made a successful trip from Tunis to Biskra and return during the latter part of March. Starting on the morning of the 27th from Biskra, he reached Tunis and returned on the following day, the total distance being 264 miles. The voyage across the sand-dunes was a fine one, and the 12 horse power machine made a good performance, overcoming the various difficulties of the route. The Arabs of the desert gave him a warm welcome, and the cadi of Tuggurt did him the honor of a special reception. The return from Tunis was made in 11 hours, in spite of a violent sirocco. This is the first appearance of the automobile in this part of the Sahara. A good horse takes two or three days to cover the same route, and the caravans eight days.

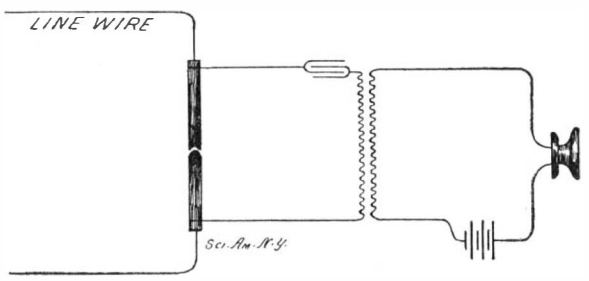
The progress of military automobilism in Germany is indicated by the fact that the Minister of War has lately ordered a series of machines which will carry two small Maxim guns, protected by nickel steel plates. He has also ordered a series of automobile breaks which will be provided with tables. These breaks are to be used by the Etat Major, and the officers may thus consult their maps or papers *en route*, spreading them upon the tables. A series of light vehicles, or voiturettes, is also to be constructed, to be used on the firing grounds for ascertaining the results of the cannon-shot. In Austria-Hungary, the Minister of War is having a series of automobiles constructed; these are of a new type, and will be used for the rapid transportation of troops in time of war. By the use of these machines it is hoped that the use of temporary campaign railroads may be done away with. This series of automobiles is to be tried during the grand maneuvers which will shortly be held.

The competitive test of carburants, organized by the Automobile Club of France, promises to be of considerable interest. Now that the use of alcohol, more or less combined with gasoline, is coming to the front, the tests will be of value in finding out the comparative efficiencies of these two combustibles. The question of alcohol has been the subject of some controversy of late, and its value for motors, while strongly upheld by some authorities, has been disputed by others. The tests will be held at the laboratory of the club near Paris, beginning May 1. According to the rules which have been published the standard of comparison is to be gasoline of the kind used for automobiles, of density 700 degrees at the temperature of 15 deg. C. The trials are to be made with three different types of motors: high speed motors with small stroke, 3.2 by 3.2 inches and 1,300 to 1,600 revolutions; those of mean speed and small stroke, 3.2 by 4.8 inches and 850 revolutions; and those of slow speed and long stroke, 4.4 by 6.4 inches with 650 revolutions. Two principal points will be taken into account in the tests. First, the consumption of combustible per horse power hour, measured on the shaft of the differential at different speeds of the motor. To this end a series of curves representing consumption and speed will be made for the standard gasoline and for the carburant under test, this to be carried out under the best conditions of carburation, ignition, cooling, lubrication, etc. Second, as to the condition of the different parts of the motor after a 10 hours' continuous run and a night of rest, without cleaning. In case a type of carbureter has been designed which is especially adapted for a certain carburant liquid, these may be tested together with the different motors. The selling price of the carburant is to be indicated, as well as the percentage of alcohol it may contain. A commission of experts has been appointed to carry out the tests, and a detailed report of the results will be published. Medals and certificates are to be awarded for satisfactory products or apparatus.

A WHISTLING ARC.

BY FRANK C. DANIEL.

Some very interesting experiments have been recently performed at Dickinson College by Mr. Charles C. Dunning on the effect of rapid variations in the current of a direct current arc. In December last it was demonstrated by Mr. W. Duddell before the Institute of Electrical Engineers that when the current of an arc varied a contraction or expansion of the vapor column resulted. When the variations were



THE WHISTLING ARC CIRCUIT.

sufficiently rapid musical notes and articulate speech could be produced.

To demonstrate this interesting phenomenon Mr. Dunning used an ordinary arc lamp furnished with a current of ten amperes. The arc was shunted through a one-third M. F. condenser and the secondary coil of a telephone transmitter. The primary coil was placed in circuit with a transmitter and a storage battery of two cells.

The above diagram will show the connections. The transmitter was placed in a distant part of the building.

When the arc was lighted and a tuning-fork was held in front of the transmitter, the note was reproduced by the arc The best results were obtained by whistling into the transmitter. By this means the arc was made to whistle a tune, which it did perfectly, reproducing every note loud enough to be heard at a distance of twenty or thirty feet. When the transmitter was spoken into, sounds were produced by the arc, but it was difficult to distinguish any words. The experiment is easily performed and is very well adapted to the lecture table.

Lead Pencils in Germany.

Under date of March 15, 1901, Consul Hughes, of Coburg, writes: The lead-pencil industry in Germany is at present suffering from American competition. It is alleged that our success in this branch of industry is mostly due to the perfection of the machinery. Another important point is the fact that we have the best cedar wood, which is particularly suitable for the manufacture of lead pencils; while the Germans are compelled to import it and cannot get it in such good quality. Numerous trials have been made to find another material which could take the place of wood in the manufacture of lead pencils; metal tubes, coverings made from rolled, compressed paper, etc., have been used, but none has met with success.

The alumni of Cooper Union recently unveiled a tablet in the main hall of the building in commemoration of the hundredth anniversary of the birth of the founder of the institution. Although the centenary of the natal day of Peter Cooper was February 12, 1891, the tablet was completed only this year.

Engineering Notes.

The automatic sale of railway tickets on Berlin local lines has proved remarkably successful last year. There were 192 automatic machines which sold over 30,000,000 tickets. More than 200,000 tickets were delivered through the slot at the Friedrich Strasse and Zoological Garden stations.

Consul Caples, of Valparaiso, January 28, 1901, reports, as an instance of the increasing trade in railway material between the United States and Chile, that within the past week the Pittsburg branch of the Carnegie Steel Company has sold 16,000 tons of steel rails to the Chilean government, to be delivered in the near future.

The longest stone arch bridge in the world is under construction at Luxembourg, over the valley of Petruffe. This arch will have a span of 277 feet and a rise of 102 feet. The total width of the available roadway is 52 feet, and this width is divided into two parts by a space 19 feet wide, covered by slabs of armored concrete and carrying the footways.

A passenger train on the Minneapolis, St. Paul and Sault Ste. Marie Railroad was recently delayed an hour by heaps of Russian thistles which had been blown upon the track by heavy winds, says The Railway Review. The thistles were caught on the wire fences along the right of way, where they collected in bunches in much the same manner in which snow drifts into railroad cuts.

It is estimated that a Pan-American railway would stretch over 10,220 miles, being the distance from New York to Buenos Ayres. It is estimated that it will cost $200,000,000. The length of the line would be distributed among the different countries as follows: United States, 2,034 miles; Mexico, 1,644 miles; Guatemala, 169 miles; San Salvador, 220 miles; Honduras, 71 miles; Nicaragua, 209 miles; Costa Rica, 320 miles; Colombia, 1,065 miles; Ecuador, 668 miles; Peru, 1,785 miles; Bolivia, 587 miles, and Argentina, 1,050 miles.

A road made of slag cement is to be constructed at North Tonawanda, N. Y. The Tonawanda Iron and Steel Company has received permission to lay tracks on a road which is now in poor condition, provided it will slag the roadway for its full width of 66 feet. The street is about 40 feet wide. The method of laying this particular surfacing is probably novel. The molten slag is to be run in a "hot train" of iron cars over the track, and the slag poured over the surface at the proper place. The company claims that it will cool into a solid mass.

Notwithstanding the success of the new Central London Electric Railway, it does not appear to be highly remunerative to the shareholders. At the recent half-yearly meeting, for the first time since its inauguration, some authentic particulars were given regarding its passenger traffic and receipts. Throughout January the daily number of passengers carried averaged 108,000. Up to the time of the report 15,000,000 people had been carried, of which number 1,500,000 were workmen, who had been conveyed for four cents the round trip, which is half the regular fare. The receipts showed a profit of $1.20 per mile. It is intended, if the traffic does not increase, to raise the fares.

An important addition to the defenses of the Rock of Gibraltar has been made recently, says the Daily Telegraph correspondent. Four huge reservoirs have been cut out of the side of the rock above Willis' Road, and capable of storing some 5,000,000 gallons of water, which, in any possible event of siege, would be invaluable to the garrison. Even for present use a pure supply of water is at hand, enough to fulfill the wants of the place in the driest of years, and to spare even then. Each tank, by means of wire gauze over the inlets and exits, can be made mosquito-proof, thus preventing this pest, prevalent in the hot weather, from introducing any germs of disease as supposed under the new theory.

British steel manufacturers are waking up to resist the incursions of the American Steel Trust. The leading iron and steel manufacturers are co-operating together to preserve British trade. Large tracts of rich iron ore land have been purchased in Portugal and Norway by British syndicates for obtaining the raw material. In the case of the Norwegian iron deposits, Edison's magnetic extraction process is to be utilized upon an extensive scale. The experiments have proved that the process is singularly adapted to the country. The price of iron in England has fallen considerably within the last few weeks, and the installation of the latest plants into the workshops will enable the British manufacturers to fill their contracts with greater celerity. One leading firm has installed $10,000,000 worth of plant during the last twelve months, and guarantees to fulfill contracts in the same time that the American manufacturer can complete them. The prices are also considerably lower. In view of the increased tariff upon American machinery into Russia, the British manufacturers are straining every nerve to introduce their specialties, and their efforts are meeting with success.

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LAUNCH OF THE BATTLESHIP "OHIO."

The launch of the battleship "Ohio" at the Union Iron Works, San Francisco, which occurred on May 22, was a notable event. It took place in the presence of the President of the United States and several members of his Cabinet, including the Secretary of the Navy, besides the Governor of Ohio and a large number of other distinguished guests. The crowd of lookers-on numbered fully 100,000.

The battleship "Ohio" is a sister ship to the "Maine," now building at Philadelphia by William Cramp & Sons, and the "Missouri," now being built at Newport News. Its dimensions are: Total length, 388 feet on the load water line, 72 feet 2½ inches extreme breadth, and a mean draught of 23 feet 6 inches, at which she has a displacement of 12,300 tons. The full load displacement will be 13,500 tons. The contract speed is 18 knots, the greatest, in this respect, of any battleship yet built for the United States navy; though it will be surpassed by ships of the "Georgia" class, of which 19 knots are expected. An increased speed for heavy battleships is one of the most marked tendencies of the naval construction of to-day; in fact, the Italians have gone so far in this respect that their latest battleships, or cruiser-battleships, as they should be called, are to have a speed of over 22 knots an hour.

The "Ohio" combines practically every improvement known in naval construction at the present time. She is surrounded by a coffer dam filled with cellulose extending along the water line from stem to stern. The hull is protected abreast of the engines and boilers by a side armor belt extending 3 feet 6 inches above the water line and 4 feet below. This belt is 11 inches in thickness for a depth of 4 feet 6 inches, whence it tapers to a thickness of 7½ inches at the bottom. Casemate armor, 6 inches thick, extends from the side belt to the upper deck. At the ends of the casemate armor, diagonal armor 9 inches thick extends from the side of the vessel to the barbette.

The "Ohio" and her sister ships are the first of the United States warships to be fitted with submerged torpedo tubes. They project from each side of the hull about 50 feet from the bow and 10 feet 6 inches below the water line.

The "Ohio" is provided with two military masts with signal yards. The foremast is located over the forward conning tower, which is protected by armor 10 inches in thickness. The conning tower aft has a protection of 6-inch armor. The speaking tubes and electric signals of the forward conning tower are inclosed in a tube 12 inches in diameter surrounded by steel 7 inches thick. This tube extends below the protective deck. The machinery and boilers are protected above by a protective deck, worked flat within the casemates and sloping forward and aft to bow and stern. The center of the protective deck is 2¾ inches thick, forward it is 4 inches and aft 3 inches in thickness.

The armament of the "Ohio" consists of four 12-inch breech-loading rifles, sixteen 6-inch rapid-fire guns, six 3-inch rapid-fire, eight 6-pounder rapid-fire, six 1-pounder rapid-fire, two 3-inch field guns, and two Colts. The main battery consists of four 12-inch 40-caliber breech-loaders, placed in the two turrets, and the sixteen 6-inch rapid-fire, of which ten are placed in the casemates, two are on the berth forward protected by 6-inch armored sponsons and four are on the upper deck. The turrets are operated by electricity, a complete rotation being accomplished in one minute. The magazines of the "Ohio" can store 240 rounds of ammunition for the 12-inch guns, 3,200 for the 6 inch, 9,000 rounds for the 6 pounders and 4,000 rounds 1-pounder.

Electricity for lighting the battleship, operating the turrets and conning towers, hoists, etc., is supplied by eight 32-kilowatt generating sets, having a pressure of 80 volts at the terminals. There are four dynamo rooms and as many powerful searchlights.

The engines of the new battleship are in duplicate, rights and lefts, and each in a separate water-tight compartment. They are of the vertical, triple expansion type, with cylinders 38½, 59 and 92 inches respectively in diameter and 42 inches stroke, with a main condenser of 9,600 square feet cooling surface, and an auxiliary condenser of 800 square feet surface. With 126 revolutions the engines are expected to develop 16,000 horse power.

The boilers are of the Niclausse type and number twenty-four, arranged in three groups. Total area of heating surface, 58,104 square feet; of grate surface, 1,353 square feet. They are designed to withstand a working pressure of 250 pounds to the square inch. The normal coal supply is 1,000 tons, though bunkers holding double this quantity are provided.

The "Ohio" carries fourteen lifeboats, including two steam cutters 40 and 34 feet in length. She is also provided with bilge keels, to reduce rolling. Steering the vessel is accomplished by hydraulic gearing. The valves of the gear are connected by electricity with the conning towers as well as by mechanical connection with the pilot house. In commission the "Ohio" will carry 35 officers and 511 men. The construction of the "Ohio" was authorized by Congress on May 4, 1898, and her keel was laid April 22, 1899. The contract price was $2,899,000, exclusive of armor and armament.

The occasion of the launch of this fine battleship presents a fitting opportunity to say something of the celebrated yards in which it was built. From the very commencement of the reconstruction of our navy, the Union Iron Works has been noted for the great success which has attended the vessels that have been built upon its stocks. In proof of this it is sufficient to mention the "Olympia," Dewey's flagship at Manila Bay, and the "Oregon," whose trip around Cape Horn, and subsequent overhauling of the fast cruiser "Christobal Colon" at Santiago, are among the most notable naval feats of the Spanish-American war.

The plant of the Union Iron Works is located in South San Francisco, on the shores of San Francisco Bay. The harbor is entered by the famous Golden Gate; and as the latter is admirably placed for defense, the location of this important yard is everything that could be desired from the strategical standpoint. The history of the works dates back to the year 1849, at which time it was represented by a small foundry, which amounted to little more than a blacksmith shop. In 1885 the business was removed from the city proper to the twenty-three-acre site in South San Francisco, when the concern took the name of the Union Iron Works. The change of site and general reconstruction were stimulated by the desire to share in the work of upbuilding the United States navy, and in preparation for this task the buildings were laid out and constructed on the most modern lines, and a plant particularly suited for the heavy work of warship construction was laid down. Many acres are covered by the foundries, machine shops, boiler shops, etc., which are of brick, while twice as much area is required by the covered works, the shipyards, slips, drydocks, etc. The fitting shops, erecting shops, foundry and boiler shops are all spanned by heavy traveling cranes, and in the equipment are found many special machine tools of exceptionally large size and great convenience of operation, many of which were designed and built especially for this plant. Some of these tools weigh over 100 tons each. The plant is furnished with a high-pressure hydraulic system which is utilized for lifting, forging, riveting, shearing, etc.

One of the most interesting features is the large hydraulic drydock, which was designed by the Union Iron Works for their own use. The lifting-platform is built of a series of five longitudinal and thirty-six transverse girders. It is 6 feet 4 inches deep at the center and 2 feet 10 inches at the sides. The length of the platform at the keel is 436 feet 6 inches and its width 65 feet 7 inches. It is raised and lowered by thirty-six cast-iron rams, each 30.7 inches in diameter, with a lift of 14 feet 6 inches. At the top of each ram is a 6-foot sheave grooved for eight 2-inch diameter steel ropes. The ropes are attached to the platform and are carried up over the sheaves and down to the base castings of the rams. The maximum lift of the platform is 29 feet, the maximum lifting capacity 6,000 tons. In lifting the empty dock a pressure of 275 pounds to the square inch is used, and in lifting the loaded dock a pressure of 1,250 pounds to the square inch. From the year 1887 to the year 1896 an average of a little over ten vessels per month made use of the dock, and the total tonnage accommodated in this period was 1,228,605.

The first vessel of the new navy undertaken by the Union Works was the "San Francisco," a cruiser of 4,098 tons and 19.5 knots speed, which was launched October 16, 1893, which had the distinction of being the "Monterey," of 4,000 tons and 13.6 knots speed, launched April 28, 1891. Then followed the celebrated "Olympia," 5,870 tons and 21.6 knots. She was launched November 5, 1892, and in respect of her high speed, effective battery and handsome appearance can to-day compare favorably with many vessels that have the advantage of nearly a decade of subsequent improvement in the art of warship construction. The next vessel was the battleship "Oregon," launched October 16, 1893, which had the distinction of being the fastest battleship at that date in the United States navy. Then followed the two 1,000-ton gunboats "Marietta" and "Wheeling," which were launched March 18, 1897. Next the "Wisconsin," a battleship of 11,565 tons and 16 knots speed, was launched November 26, 1898. Following her was the torpedo boat destroyer "Farragut," which achieved a trial speed of 30.3 knots. On September 8, 1900, the monitor "Wyoming," 3,235 tons and 11.5 knots speed, was launched. At this yard there are also many vessels still upon the stocks or in various stages of completion, such as the semi-protected cruiser "Tacoma," 3,500 tons and 16.5 knots, the three torpedo boat destroyers, "Paul Jones," "Perry" and "Preble," and the submarine boat "Grampus." To these must be added some of the finest vessels of the naval programmes of the past two years.

Science Notes.

The government of Prussia is about to establish public libraries. For cities, permanent libraries and public reading rooms will be maintained, while for the rural districts movable libraries will be supplied.

The trustees of the British Museum have recently transmitted a beautifully illuminated address to the Emperor Menelik expressing their thanks for the assistance and facilities which his Majesty has accorded of late to British travelers who have undertaken journeys to Abyssinia for the purpose of scientific exploration.

The Prussian government has advised the various communities in Prussia that they should erect, at their own risks, cheap dwellings for employes, the laboring population, and persons of relatively small income. It also urges electric lines for quicker suburban communication, and mentions a number of legal steps which will prevent excessive real estate speculation.

The British people consume nearly six pounds of tea per head of the population, or an increase of one pound per capita in sixteen years. There is no other country which, in any way, approaches this. Holland is the only country in Europe where the consumption of tea exceeds one pound per head. In Russia and in the United States also, which are the other two large tea consumers, the consumption amounts to under one pound per head.

The method of sweating Connecticut Valley wrapper tobacco by artificial heat is to keep it at a temperature of from 90 degrees to 100 degrees, so as to obtain something akin to tropical conditions. The temperature of the rooms, when the experiments were first tried, was from 140 degrees to 160 degrees, and it was then the practice to keep the leaf moist. Now the leaf is kept drier until the end of the operation, when more moisture is used in cooling off.

The most important event of the year 1899-1900 in Greece was the finding in Crete of the vast Mycenæan palace at Cnossus, with its corridors, store-chambers, throne room, east and west courts, frescoes and library of clay tablets in Mycenæan characters. In Asia Minor the work at Priene has been finished. That begun at Miletus promises well and has already yielded inscriptions. At Ephesus a Greek monumental gateway was found which combines lintel and arch construction.

The frontier defense of the Roman Empire between the Danube and the Rhine has been under examination by a royal commission for eight years, and the work is nearly completed. At Carnuntum, in Austria Hungary, an ancient bakery has been discovered. The room contained two baking ovens and a row of charred, completely preserved bread loaves, measuring 29 x32 centimeters, says The American Journal of Archæology. Ancient bread has been known hitherto only from Pompeii.

Thomas Jefferson produced many inventions. He devised a folding chair which he used to carry to church when the services were held in the house at Charlottesville, where the seating arrangements were insufficient. This chair was composed of the now familiar three sticks, which, being unfolded and covered with a piece of cloth, made a tolerable seat or camp stool. He is also credited with the revolving chair, which is now such a familiar and necessary article of office furniture. At the time it was stated that Jefferson had devised this chair so that "he could look two ways at once." He also invented the copying press, and he sent one of his own devising to Lafayette as a present. He invented a hemp break, a pedometer and a plow. The latter received a gold medal in France in 1790. He sent the original design to the Royal Agricultural Society of the Seine, and they awarded a medal for it. Eighteen years afterward the society sent him a superb plow containing his improvement.

The action of alcohol upon metals is peculiar. Dr. Malmejac in his experiments used 95 per cent alcohol, which left no residue on evaporation. The metals copper, iron, tin, lead, zinc, and galvanized iron were corked up with alcohol in glass flasks and kept at ordinary temperatures for six months. The copper was entirely unacted upon, but in all the other flasks there was a deposit on the bottom and the metal was covered with a similar deposit. In the case of tin, lead, zinc, and galvanized iron, the deposit was white; that from iron was red, resembling iron rust, says Science. All of the liquids, except that in which the lead had been placed, filtered clear; the latter retained its murky appearance after repeated filterings through double filters. The clear filtrates from iron, lead, zinc, and galvanized iron gave much residue on evaporation, while the residue from tin was hardly appreciable. In the former cases it is clear that not only had the metal been oxidized, but a considerable quantity had entered into the solution. These experiments have an important bearing on the storing and shipping of alcohol, as absolute alcohol is generally purchased in galvanized iron cans, so that it ought to require redistillation.

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THE CULTIVATION OF COCOA IN THE WEST INDIA ISLANDS.

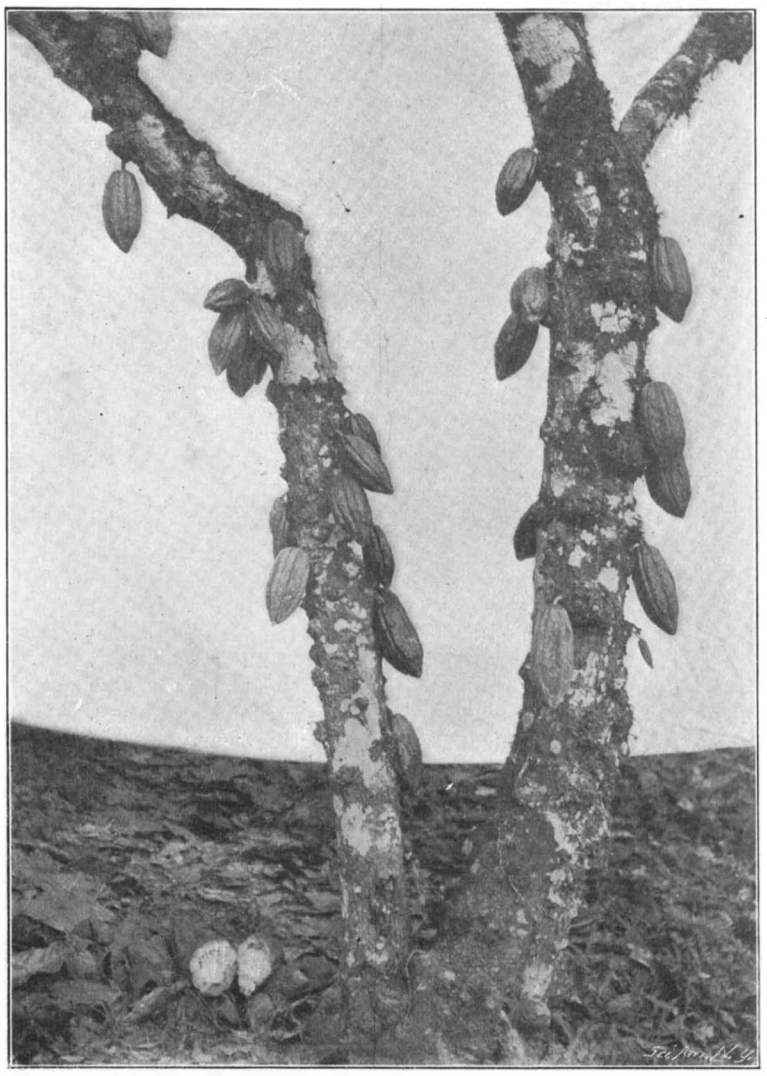
To the active young man possessed of a limited amount of capital, who is looking for an occupation as well as investment, in the Lesser Antilles or in many parts of Venezuela, the cultivation of cocoa is at the present time the most inviting of the agricultural pursuits. The island of Trinidad, which is the one most familiar to the writer, produces cocoa of a quality second to none, and only equaled by that grown in the vicinity of Caracas, and always brings the highest price in the London market. Considerable patience is required to grow it from the seedlings, as it takes five or six years of cultivation before there is a harvest worth mentioning, and seven or eight years before a full crop can be realized, but when the trees are once full grown they will continue to bear fruit for an almost indefinite time.

Cocoa has been grown on this island, as early as 1700, in considerable quantities, and there is so much of its area under cocoa cultivation that it is always possible to purchase bearing plantations at a price that would make a paying investment for the man who will give his own time to the management. Want of proper care seems to be the cause of more failures than the lack of the trees to produce paying quantities, or the market price of the product.

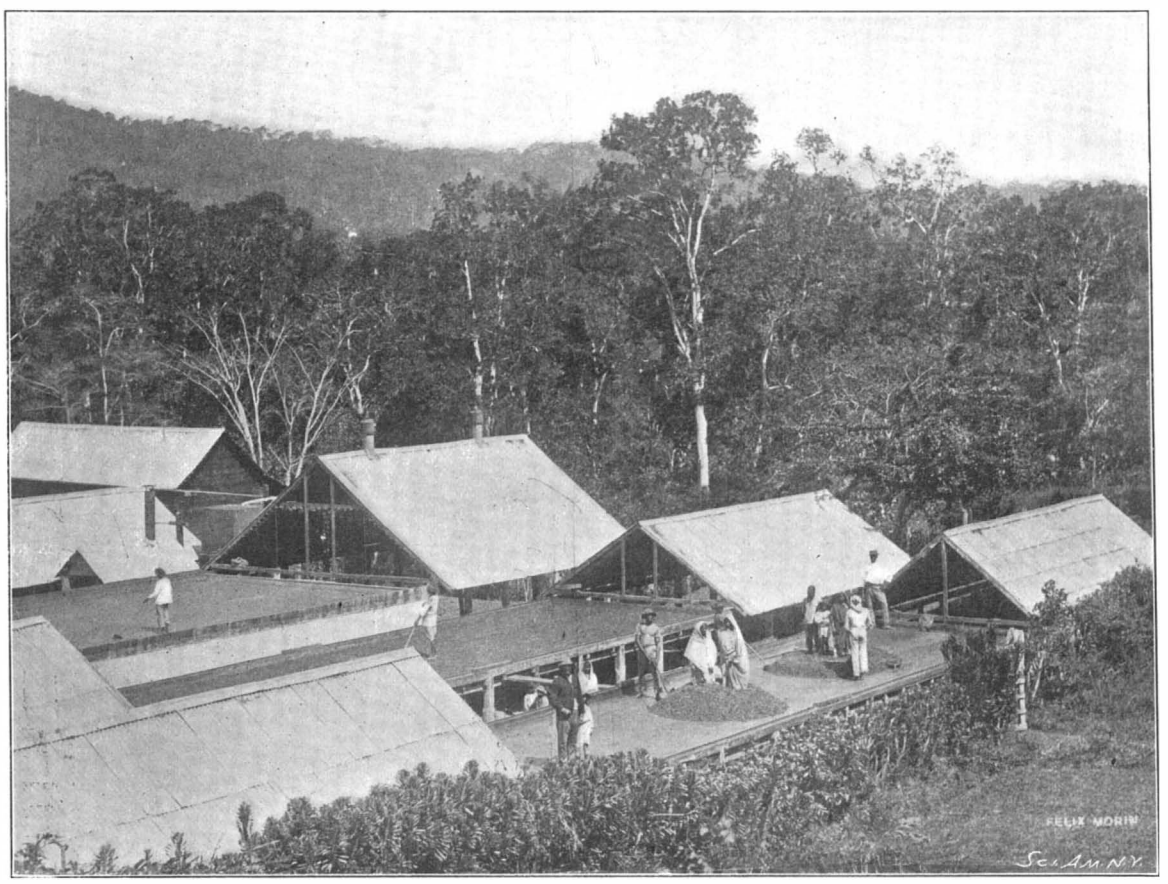
The cocoa tree seems to flourish best in the rich and well-watered soil along the banks of the many ravines that traverse the uplands of the island, where they are more or less protected from the violent storms. The small plants are reared in nursery grounds until they are ten or twelve inches high, when they are planted in rows like a northern fruit orchard. The cocoa tree must always be protected from the powerful rays of the tropical sun, that seems to blast the fruit. When young, they are shaded by growing bananas or plantains adjacent to the young tree; these grow very rapidly and furnish the required protection, as well as a source of some profit, while the cocoa is too small to bear. But it is necessary to provide for a future shade—for the cocoa after three or four years outgrows the banana—and for this purpose a tree known as the "Bois Immortel" (sometimes called the "Mother of the Cocoa") is planted at the same time as the cocoa tree; this is a tall tree with high and spreading branches that form a sort of canopy over the entire cocoa plantation and give it the required shade, making it resemble an open forest. The Immortels are shown in the illustration immediately behind the dry-houses, with the smaller cocoa trees underneath. The coffee tree, which is much smaller than the cocoa, is often grown in small quantities among the cocoa.

The cultivation of cocoa consists largely of draining the land, keeping down the undergrowth of bush and weeds, and trimming the trees. The flowers occur in clusters on the main branches and on the trunk of the trees, usually only one of each cluster reaching maturity. The fruit, which is seen in the illustration, is a hard pod six or seven inches long, resembling a cucumber, growing from the trunk or large branches, and looks very much as though it were artificially attached. Buds, blossoms and fruit, in all stages, occur side by side, and ripened fruit is harvested at all times of the year. The main crop, however, matures in the dry season and is usually harvested in February; only small quantities ripening during the remainder of the year.

The pods each contain five rows of seeds or beans, quite similar to a large, thick Lima bean, embedded in a pink, acid pulp. These seeds are the cocoa beans of commerce. The harvesting consists of cutting off the mature pods by means of a knife on a long bamboo pole, gathering them into heaps on the ground, where they are allowed to lie for about twenty-four hours. They are then cut open with a cutlass, the seeds and pulp coming out in a mass; these are carried to the dry-house. The dry-house consists of a smooth, tight floor, or platform, set on posts at a height of four or five feet above the ground to allow a free circulation of air underneath. A light iron T-rail is spiked on each side near the edge and extending one-half the length of the floor beyond each end; a corrugated iron roof, with its eaves level with the floor, covers the platform. This is carried on a frame, divided in the middle of the floor, mounted on small car wheels traveling on the rails. The drying of the beans is accomplished on this floor by spreading them over it and exposing them to the sun. The roofs are to protect them from the rain and dews, and are kept wheeled back on the extended tracks when the sun is shining. As soon as the beans reach the dry-house, they are placed in the "sweat box" or pit, where they are closed up tight and allowed to ferment for some time. This process requires very careful attention to prevent the temperature from getting too high and to stop the fermentation at the proper time to insure the proper flavor, as well as the fitness for the preservation of the beans.



COCOA PODS ON THE TREE.



COCOA DRY-HOUSES IN TRINIDAD—MIXING THE BEANS.

The next process is the drying, which is accomplished by spreading the beans in a layer over the platform and drying them in the sun. Laborers are kept constantly stirring them, while exposed to the sun, with a wooden rake, so that they will dry evenly. Each morning, during the early stages of the drying process, the beans are gathered into a heap in the middle of the floor and given a thorough mixing. This is sometimes accomplished by the laborers mixing and kneading them by treading them with their bare feet, as shown in the illustration. This is known as "dancing the cocoa" and renders the beans smooth and uniform in color. It usually requires ten days or two weeks to finish the drying, depending on the weather; a great many attempts have been made to dry the beans artificially with more or less satisfactory results, but no generally satisfactory drier has yet been designed, and the open dry-houses are in general use throughout the island. It only remains, however, for some ingenious mind to make a careful study of the requirements. The most difficult problem seems to be to get an artificial drier that will give the proper color to the dried beans—the brick-red color, and the property of retaining it is a very important feature in the cocoa market. The dried beans, when ready for market, are put in canvas bags holding about 150 pounds, and the name of the plantation stenciled on the bags, these names or brands at times becoming very prominent in the market for the quality of cocoa the plantation is reputed to produce.

The manufacturing, which is invariably done in northern factories, consists of roasting the beans in a revolving cylinder; this develops the aroma and fits them for crushing. After the beans are crushed they are screened to separate the "nibs," or crushed nuts, from the shells. The nibs are then ground to a fine meal; this is put in sacks and put in a powerful press, where it is subjected to heat and pressure, and the fat, known as "cocoa butter," is squeezed out, and the hard substance left in the sack has only to be broken or powdered to became the pure chocolate, and this more or less adulterated is the chocolate of commerce.

THE PAN-AMERICAN EXPOSITION.

The Pan-American Exposition is rapidly nearing completion. There still remains considerable work for the gardeners, and a number of exhibits are yet to be installed. All of the principal buildings are entirely finished, and only a few minor structures are in a state of incompleteness. A notable exception, however, is the Art Building, which will not be opened for some weeks. We present a number of engravings prepared from photographs taken by the staff-photographer of the Scientific American. They embrace a number of new views and subjects which have not before been photographed. The current issue of our Supplement is largely devoted to the Exposition and contains a large number of engravings of the various buildings and groups of statuary, and is accompanied by an extended article.

The pictures which we publish this week are intended, as far as possible, to give an idea of the attention which has been given, not to the buildings proper, but to what might be considered special features of the Exposition, such as the effects produced by the aid of canals, bridges and landscape gardening. The mall which connects the two most important entrances, which are most used by visitors, is spanned and decorated with orna-

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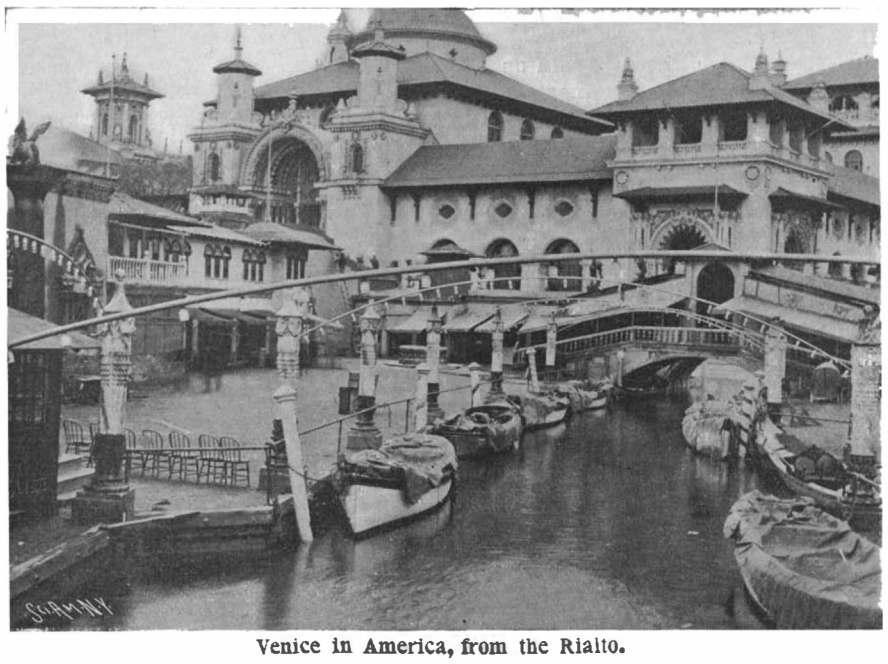


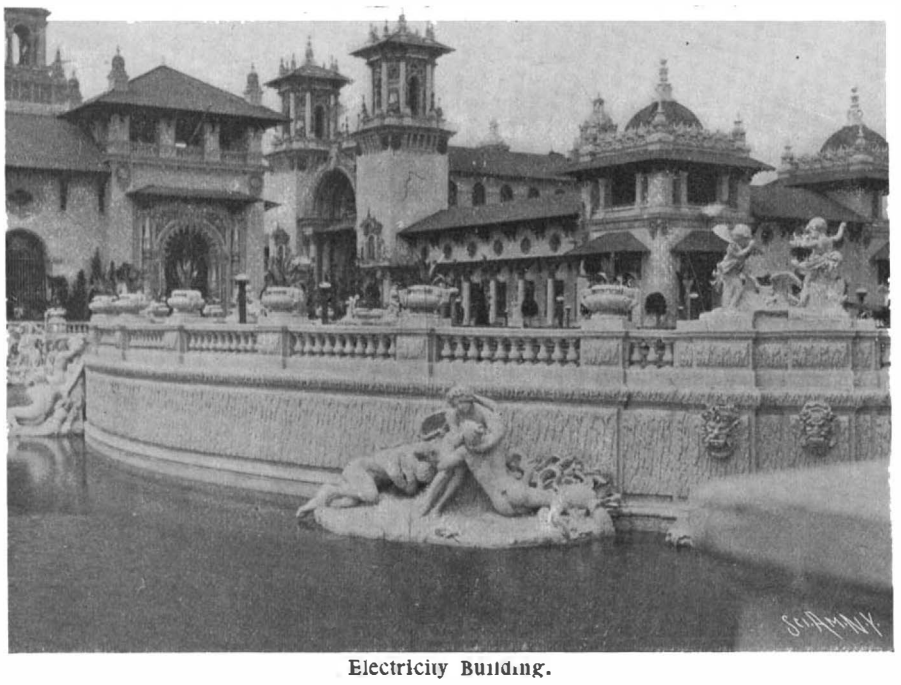
Venice in America, from the Rialto.

One of the Small Canals.

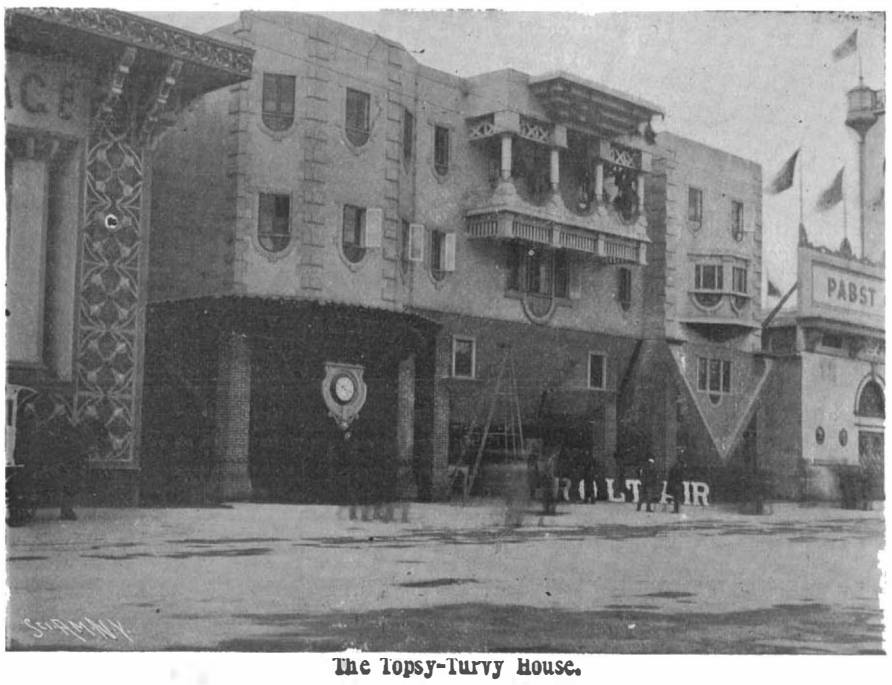
The Horticultural Building.

The Mall.

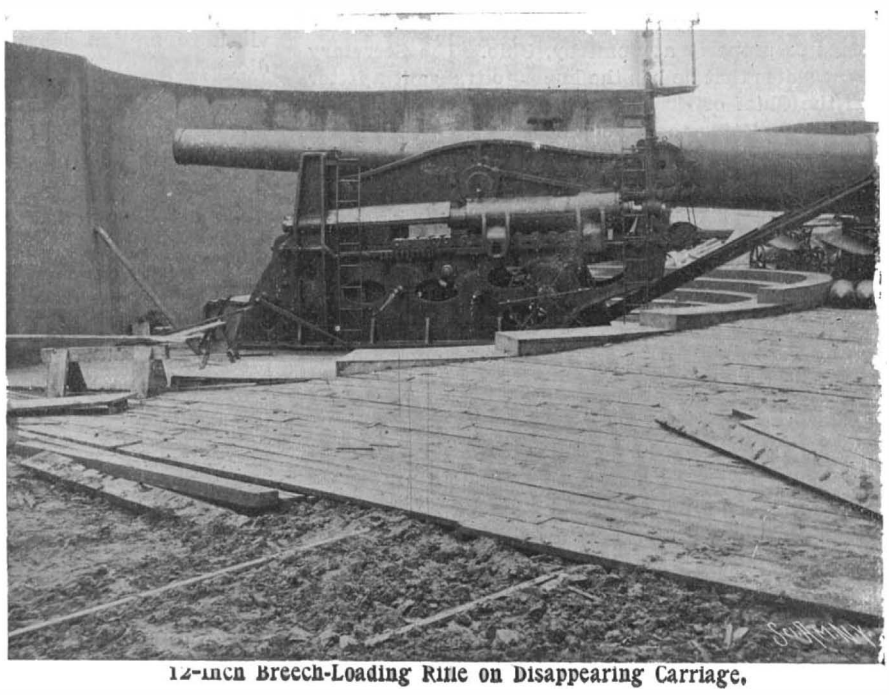
Fountain and Agricultural Building.



Electricity Building.



The Topsy-Turvy House.



12-inch Breech-Loading Rifle on Disappearing Carriage.

BITS OF THE PAN-AMERICAN EXPOSITION.

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mental trees and shrubbery. It is embellished by statues, and is lighted at night by posts, the top of each being a mass of small incandescent lights, for the arc light is banished from the grounds except for illuminating outskirts of the reservation, the result being there are no excessively bright points to strike and offend the eye. The Grand Canal, which is over a mile in length, extends around the central group of large buildings, and is shown in several of our engravings. The outer bank of the Canal and the banks of the lagoons are sodded and set with trees and flowers, producing vistas of great beauty. The canals are crossed by many bridges, and statues, groups of statuary and fountains are distributed with a lavish hand. The buildings with their polychromatic decoration compose admirably with the water, bridges, statuary, trees and flowers.

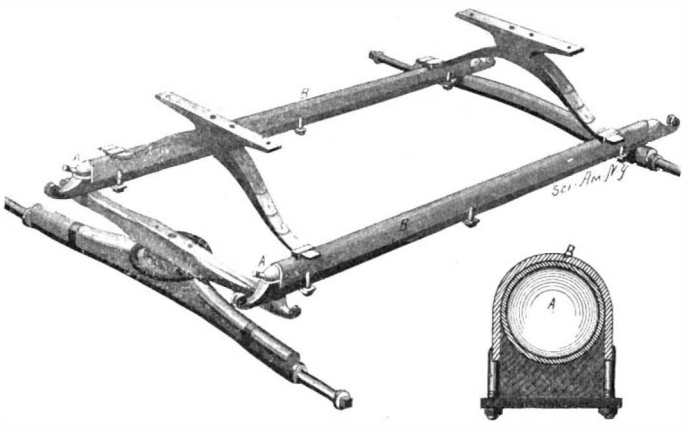
Even the attractions of the Midway in many cases fit in admirably with the architecture of the buildings. This is especially the case with "Venice in America," which is composed of a number of replicas of Venetian palaces, shops, bridges and canals, and gondolas, with real gondoliers, can be engaged to make the circuit of the Canal. The "Topsy-Turvy House" is one of the oddest attractions on the grounds. It represents a house standing on its roof. The visitor enters through the roof and after going up or rather down several flights of stairs, he reaches the cellar, which is converted into a roof garden. Even the flower-pots on the balcony are upside-down. One of the most interesting exhibits is the 12-inch breech-loading rifle on a disappearing carriage, which is in the rear of the Government Building. The government exhibit, as a whole, is remarkable for its completeness, and the visitors are sure to appreciate this fine example of American ordnance manufacture.

A PNEUMATIC SPRING FOR VEHICLES.

The shocks to which a vehicle is subjected as it travels over an uneven road are absorbed in a novel way in an invention patented by William W. Humphreys, of Sheffield, Ill.

The two parallel reach-bars, connecting the front and rear axles, are concaved to receive two long pneumatic cushions, *A*, each closed at one end and provided with an air-valve at the other end. Curved saddle-plates, *B*, are carried by the cushion-springs to support the vehicle-body, and are prevented from being accidentally displaced by means of bolts.

When the cushions are inflated, the jolting of the vehicle is so thoroughly absorbed, that only a gentle rocking motion is felt by the occupants. Automobiles



PNEUMATIC CUSHION FOR VEHICLES.

and two-wheeled vehicles can also be fitted with the pneumatic cushion.

Document 384 of the Fifty-sixth Congress.

We have received Document No. 384 of the Second Session of the Fifty-sixth Congress, dealing with the damage to property at Pomeroy, Ohio. The Secretary of War states that he has the honor to transmit a letter from the Chief of Engineers, U. S. A., submitting certain facts relative to the claim of Mrs. B. N. Reuter, amounting to $1, for damages to a window and curtain in her residence, caused by a fragment of rock thrown by a blast by government employes while removing rock from the river bed and banks of the Ohio River, at Pomeroy, Ohio. The Chief Engineer considers that damages inflicted by the torts of the government officers or agents are in the nature of unliquidated damages which no executive officer has authority to settle. He therefore recommended that Congress be asked to insert the following amount in the next general deficiency bill:

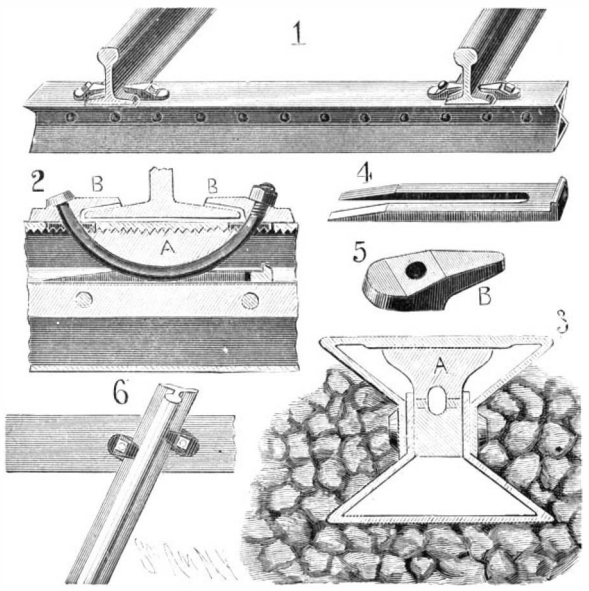
POMEROY, OHIO, November 5, 1900.
U. S. Government to Mrs. B. N. Reuter, *Dr.*

To one 14 x 32 double-strength glass	$ .50
Glazing same	.25
One curtain damaged	.25
Total	$1.00

The estimated number of telephone exchange connections in the United States is 1,825,000,000 annually.

A NEW METAL RAILWAY TIE.

Perhaps no railway appliance contains so much promise for the future as the metallic tie; for the time will soon come when our fast-disappearing forests must necessitate the abandonment of the wooden sleeper for the more durable and stronger metal tie. The illustration which we present herewith pictures one of the latest attempts which have been made to provide a metal tie which will answer the needs of the modern railway. The inventor of the tie is Mr. Chester Rabert, Coalburg, W. Va. Fig. 1 is a general view of the tie; Fig. 2 is an enlarged sectional view; Fig. 3 is an enlarged cross



A NEW METAL RAILWAY TIE.

section of the tie; Fig. 4 shows a split-wedge employed; Fig. 5 represents a novel washer serving to hold the rail in place; and Fig. 6 shows a method of securing the rail at any angle and at any point on the tie.

The tie is composed of interlocking upper and lower sheet-metal sections. The sections are so bent that the general outline of the tie in cross section, as shown in Fig. 3, shows a wide flat base and top, sharply re-entrant sides and corresponding vertical parallel side portions. Interposed between the side portions is a reinforcing block of metal, extending the entire length of the tie. The vertical portions and the block are firmly bolted or riveted together. By reason of the peculiar hollow form this construction combines great strength and lightness. Downward strains upon the upper section of the tie are concentrated upon the reinforcing block.

Each rail, as shown in Fig. 2, is secured to the tie by a curved bolt extending through openings in the top of the tie and seated in a saddle, *A* (Fig. 2); the ends of the bolt pass through washers, *B*, overlapping and securing the base of the rail. The rail is seated upon a piece of hard felt or other sound-deadening material. As shown in Fig. 5 the washers have a circular body portion designed to rest upon the upper face of the tie, and an extended lug or projection overlapping the edge of the rail-base. The under surface of each washer is cut away beneath the lug portion to form a shoulder or abutment bearing against the edge of the rail-base.

The curved bolt connecting the washers is seated in a groove formed in the under surface of the saddle, *A*, and in a recess extending throughout the entire length of the reinforcing-block. The saddle, *A*, and the lower opposing face of the top of the tie are both toothed, so that a firm interlocking connection is provided to prevent longitudinal movement of the saddle. A split-wedge of the form shown in Fig. 4 is used to straddle the bolt and to pass between the central reinforcing-block and the saddle.

As shown in Fig. 5, the rail may cross the tie and be secured to it at any angle and at any point. It is necessary merely to make two openings in the top of the tie at the proper point for the passage of the curved bolt—a construction clearly serviceable for sidings and switches.

By reason of the serrated connection of the saddle and tie the rails may be transversely adjusted to the proper gage while the parts are loose. Upon tightening the bolt the saddle and rail are positively locked against movement transversely to the rail. This done, the wedge shown in Fig. 4 is driven home. It will be seen that Mr. Rabert has invented a metallic tie which combines with the lightness of a tubular structure, unusual stiffness, and provides an unyielding bearing at the point of greatest stress. The track gage can be simply and accurately adjusted by means which obviate the spreading of the rails and yet permit readjustment without removing the rails.

Alcohol Motors.

In an address recently made by M. Oelers, a prominent engineer, before the German Distillers' Association upon the subject of alcohol motors, he brings out the following figures to show the cost per horse power hour for motors using gasoline, petroleum, illuminating gas, or alcohol, the figures being an average for several motors of each type, of the systems most used in Germany. According to these data, the gasoline motor consumes 0.77 pound per horse power hour, representing a cost of $0.031; a motor using ordinary petroleum, 0.88 pound, or $0.025; an average gas motor costs $0.021 per horse power hour; the alcohol motor uses 0.98 pound, or $0.026. The conclusions brought out by M. Oelers are that the alcohol motor runs at a less cost than the gasoline motor, at about the same cost as the petroleum motor, but at a somewhat greater cost than the gas motor. He concludes that alcohol will no doubt render great services in agriculture for engines and tractors, as well as for automobiles.

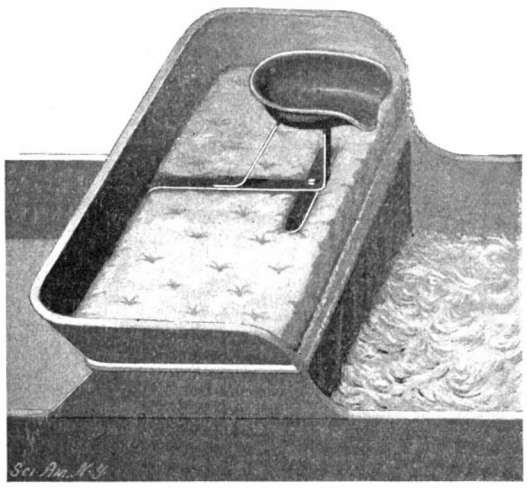
Education of German Children in Foreign Countries.

Consul Hill, of Amsterdam, March 19, 1901, reports that, in a recent German appropriation bill, provision has been made for subventions for 125 schools for the German education of German children in foreign countries. For a school at Constantinople, $7,140 is allowed; for three schools at Buenos Ayres, $4,284; for one at Galatz, $2,665; and $2,380 for a high burghal school and $238 for a deacon school at Antwerp. A high school for girls at Brussels also receives $2,380. Four schools at Bucharest together receive $2,380. A school at Pretoria is granted $1,428 and one at Johannesburg, $2,522.80. There are 29 German schools in Brazil, 12 in China, 12 in the British colonies, 12 in Roumania, 11 in Egypt, etc.

A SUPPLEMENTAL SEAT FOR VEHICLES.

Among the patents lately issued in the United States is a third seat for two-seated vehicles, the invention of Nelson Marsh, of Bernardston, Mass. The seat is bolted to a detachable skeleton-frame constructed with a horizontal part resting on the seat-cushion. A downwardly-extending hook part receives the rear end of the cushion. A firm support is provided by a cross-bar resting on the cushion.

As shown in our illustration, the supplemental seat is placed in the middle of the main seat in an elevated position so that it will interfere but little with the occupants of the main seat.



A DETACHABLE THIRD SEAT FOR VEHICLES.

The Current Supplement.

The current SUPPLEMENT, No. 1327, might be called a Pan-American number, as the Buffalo Fair occupies a considerable portion of the paper, and is illustrated by nine engravings showing many of the principal buildings and the remarkable decorative sculpture. The article was prepared after a recent visit to Buffalo by one of our staff especially for this purpose. "Signaling to Mars" is by Sir Robert Ball. "Syntonic Wireless Telegraphy" is a *resume* of Marconi's recent lecture on the subject. "The Distribution and Conversion of Received Currents" is by Henry Gordon Stott, and is accompanied by eleven engravings. "The Citizen: His Schools, His Industries, His Life," is by Prof. R. H. Thurston. "Blackfoot Amusements" is by John McLean.

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RECENTLY PATENTED INVENTIONS.

Electrical Apparatus.

SWITCH.—JOSEPH C. DE JANISCH, Avenue des Champs Elysées 121, Paris, France. Each contact-piece of the switch is operated by means of two movable buttons which project alternately beyond the casing of insulating material inclosing the contact pieces. The arrangement of the buttons, either one of which projects when the opposite button lies within the casing, obviates any cause for hesitation in operating the switch when turning on or shutting off the current.

Mechanical Devices.

ADDING-MACHINE. — DR. PIERCE HUBERT, Louisville, Ga. The principal parts of this adding-machine are a series of rotatable disks or wheels, the peripheries of which bear numerals. Pivoted levers actuated by depressible spring-keys also bearing numbers, operate the disks or wheels. The improvements devised have resulted in greater simplicity and economy of construction and in a more trustworthy and rapid operation.

LUNI-TIDAL TELLURIAN.—THOMAS MCDONOUGH, 913 Canal Street, Ottawa, Ill. By means of this apparatus pupils can be shown in a simple and convincing manner the cause of the tides and the phases of the moon, as well as the causes of eclipses and other celestial phenomena.

MACHINE FOR WHIPPING CREAM.—EMILIO MONTANI, Manhattan, New York city. The machine consists of a framework, in the upper part of which a countershaft is journaled, connected by belt and pulley with an auxiliary shaft journaled in the lower part. A beveled gear on the end of the auxiliary shaft meshes with a gear on a base-plate, which carries the vessel of cream. From the counter-shaft a support, which carries beaters, extends downwardly into the vessel. By means of belt and pulley, the beaters are rotated in the dish.

CHAIN-WRENCH. — WILLIAM H. BROCK, Long Island City, N. Y. In the wrench forming the subject of this invention two different units of adjustment are available, the one, as in ordinary wrenches, corresponding with the distance between the chain-pins and the other a fraction of this distance. The second adjustment is due to a novel arrangement of the hooks for engaging the chain. Thus finer adjustments are obtained than are possible with ordinary chain-wrenches.

AUTOMATIC LETTER-BALANCE.—JOSEPH C. DE JANISCH, Avenue des Champs Elysées 121, Paris, France. A series of weighing operations is automatically effected by means of weights corresponding each to a unit charge or load placed in the weighing-pan of the apparatus. The weights are so combined with an oscillating-lever that the load put upon the weighing-pan causes the successive rising of the weights until the beam is in equipoise. This equipoise occurs when the charge in the pan is equal to the total weight of the uplifting weights and the total weight increased by a unit charge or load. Thus, whole valuations can be automatically obtained.

CONCENTRATING-JIG.—SAMUEL ORR, Leadville, Colo. The invention provides an improved concentrating-jig for treating ores as they are brought from the mines, in order to separate the ores according to their specific gravity. The float silver and float gold are carefully saved. The jig is arranged to be worked with a comparatively small quantity of water, which can be used over and over again.

EXHIBITING DEVICE.—CHARLES E. LUCKE, Kingsbridge, Bronx, New York city. This exhibiting device belongs to a class of advertising-machines which intermittently move a band or ribbon carrying the advertisements to be displayed. In such machines it has always been a matter of considerable difficulty to bring the picture or other sign into proper position. By means of a simple compensating device the inventor has succeeded in thus adjusting the position of each advertisement, notwithstanding the variation in the diameter of the roll or band of ribbon. An improvement is also incorporated in the invention, which provides a new means of illuminating the sign.

STIPPLING-MACHINE. — GUSTAV ARNOLD, Manhattan, New York city. This machine is to be used in lithography to reproduce any design made with pencil, brush, or other drawing implement. The novel features of construction are an elastic diaphragm carrying isolated stipple-points. These points are closely related to one another and extend loosely through an apertured plate so that they are kept apart.

DRIER. — JOHN WATERHOUSE, Manhattan, New York city.—The drier is an improvement upon a machine for drying fruit, meats, sand, and the like, invented by Mr. Waterhouse and described and illustrated in the SCIENTIFIC AMERICAN of June 9, 1900. The improved drier consists of a rotary tumbler through which a series of perforated pipes extend. The perforations in the pipes are located at one side and nearest the wall of the tumbler. The pipes are supplied with air, and are consecutively opened and closed. The valve of each pipe remains open as long as it is covered with the material rolling down the sides of the tumbler.

ENVELOP-SEALING MACHINE. — ALFRED HEYDRICH, Brooklyn, New York city.—The table upon which the envelop is placed to be sealed is stationary or has a limited cushioned movement. Means for dampening the gummed surface of the envelop are provided. Sealing-rollers are moved to and from the table. By means of a gage or guide, envelops of various sizes can be sealed by the same machine. The actuating mechanism of the sealing-rollers and their carriage is so constructed that the sealing section of the envelop at the forward movement of the carriage will be received between the rollers during the return movement of the carriage in order to allow the mucilage to dissolve. But when the carriage again moves forward, the sealing-rollers are set in motion and the envelop held between them is discharged.

Vehicles and Their Accessories.

VEHICLE.—JEAN REY, Maxwell, Cal. The invention is a three-wheeled wagon especially adapted for farm and city use, and in places where a wagon and dray can be used. The wagon-bed is a platform having slats, the adjacent ends of which fit in rabbeted seats on the rear axle. At the front end of the platform is a vertically-pivoted frame. The platform, being very low, can receive its load easily and is not liable to be overturned.

BICYCLE DRIVING-GEAR. — OCTAVE ROLERT, Paris, France. The inventor has devised an elastic gearing mechanism, the different parts of which are interchangeable. Nuts, screws, and bolts are dispensed with. The gearing mechanism is based on a principle which permits the parts to be easily manufactured, and the gearing of the pinions to operate perfectly. The transmission shaft being uninterrupted and rigid, the machine is easily handled.

COUPLING FOR HAME-TUGS AND TRACES.—ORANGE A. DEAN, Toulon, Ill. The coupling is so constructed that the hame-tugs and traces can be made lighter than usual and yet to stand much more strain than when connected in the usual way. The pull on the hame-tugs is about equally divided. By means of this coupling, the trace can be lengthened or shortened through the medium of the hame-tug without punching holes in the trace.

Railway Contrivances.

ELEVATED RAILWAY.—JOHN W. GONCE, Kinderhook, Ala. The railway is particularly adapted to fill the wants of small communities. The road can be built over level or hilly country at small expense, and can be provided with either single or double tracks. A uniform tension is to be maintained in the tracks and supporting cables during the various changes of the weather,—a result achieved principally by mechanism deflecting the track laterally at intervals from a straight line and sometimes by a lengthwise pull on rails and cables.

Miscellaneous.

LAMP. — BOMONJEE DORAIJEE PUDUMJEE, Charni Road, Opp. Allbleso Pag, Bombay, India. The lamp is a triplex lamp which can be used with an oil light alone, with oil or with acetylene, or candle, or acetylene or candle alone. The lamp, although especially designed for vehicles, can also be used for other purposes by slightly modifying the construction.

SUSPENDERS AND SHIRTWAIST ATTACHMENT.—RALPH B. HEAD, Fairbury, Ill. When suspenders are worn over shirtwaists or shirts the effect is not pleasing. Hence, it is customary to arrange suspenders beneath the shirtwaist by providing slits in the material near the waistband of the trousers. The invention is an improved clasp for temporarily securing the suspender ends to the shirtwaist.

HOOK-PLATE FOR LAMPHOLDERS OF MINERS' CAPS.—AUDLEY H. STOW, Hunter, W. Va. The lamps generally used by miners consist of an oil-cup having on one side a spout for the wick and on the opposite side a hook for attaching the lamp to its holder or support. It is often necessary for the miner to remove his lamp and replace it quickly with one hand alone. With the hook-plates now in use such removal is very slow, owing to the difficulty of finding the proper hole with the end of the lamp-hook. The present invention overcomes this difficulty.

BASE-PLATE FOR LAMPHOLDERS OF MINERS' CAPS.—AUDLEY H. STOW, Hunter, W. Va. The first and main object of this invention is to provide a base-plate readily adjustable to any size of lamp, while also providing, incidentally, a base-plate having the strength of the usual ribbed base-plate. The lamp is thus kept from swinging, not merely sidewise, but in any direction. Waste oil is carried off very simply. The cost of manufacture is comparatively small.

GARBAGE-HOLDING ATTACHMENT FOR SINKS.—CHARLEY E. COX, 4824 Clark Street, Chicago, Ill. The attachment is a receptacle applied to the bottom of a slop or kitchen sink for the purpose of arresting grease and solid substances, while allowing water to pass freely into the waste-pipe. The receptacle is provided with a trap, so that foul odors cannot pass upward to pollute the air above the sink.

SKIRT-SUPPORTER. — ADA M. WALLACE, Princeton, Ind. The invention provides a simple supporter which is to be attached to a corset, and with which a skirt may be readily connected and held without danger of becoming detached. No sharp points liable to scratch or prick are anywhere present.

COMBINED CANE AND UMBRELLA.—RUFUS WAPLES, JR., 505 Chestnut Street, Philadelphia, Pa. As the title of the invention indicates, the inventor has combined a cane and an umbrella in one device. So compact is the construction that the cane, when the umbrella parts are folded, presents the appearance of a neat walking-stick.

LAMP-CHIMNEY CLEANER. — DANIEL S. ZEILER, Sumneytown, Pa. The cleaner comprises a handle; two hooks, oppositely-formed on a looped wire rod, the looped portion of the rod being bedded in an end portion of the handle, and a ferrule adapted to secure the wire loop on the handle. The hooks hold the sponge or cloth.

DRAINING DEVICE.—SAMUEL H. BOLLING, Ittabena, Miss. The object of the invention is to provide a new device especially designed for removing surface water, such as that of ponds, ditches and the like, to a lower stratum. The invention consists of a box provided with a perforated inlet-pipe, a like outlet-pipe, and an air-pipe.

DRIVE-WELL DEVICE.—CHARLES F. ALLEN and WILLIAM B. GROW, Hueneme, Cal. The invention provides novel features of construction which permit the free and rapid insertion of the well-casing into a vertical perforation in the ground without injury to the casing, and which will also permit the ready removal of the casing. The lower end of the well-casing is provided with a novel point which can be driven independently of the main portion of the well-casing. Thus, a vertical hole is produced of greater diameter than that of the casing, and thus the casing can be allowed to drop into the well-hole.

NOTE-PROJECTION. — JOHN KRUFT, West Hoboken, N. J. The invention relates to note-sheets or barrels for mechanical musical instruments, and provides an improved note-projector of peculiar formation, which is exceedingly strong and, therefore, not liable to bend or break.

SPECTACLES OR EYEGLASSES.—VERNER R. GATES, Sherman, Mich. Mr. Gates has devised a slip-lens holder of simple construction so arranged that when not in use it can be turned down toward the face and held substantially at right angles to the main lenses. These changes in position can be made without removing the glasses from the nose.

TOBACCO-PIPE.—DOMINGO J. G. FERREIRA, Butte, Mont. The tobacco-pipe is so constructed that a perfect draft is insured and a ready means provided for cleaning the pipe whenever desired. Nicotine is discharged merely by blowing through the mouth-piece.

FABRIC. — JOHN A. SCHARWATH, Jersey City, N. J. The fabric is to be used particularly as a roofing material or siding for buildings. Not only is the fabric waterproof, but also flexible, light and strong, and not liable to suffer deterioration by reason of changes in temperature.

CIGAR-TIP CUTTER. — CHARLES W. B. MOLONY, Bulawayo, Rhodesia, South Africa. The purpose of this invention is to provide a cigar-tip cutter, which, while effective for the purpose in hand, will nevertheless be so simple and cheap in construction that one may be applied to each cigar. Hence, when the tip of the particular cigar to which it has been applied is cut, the cigar-tip cutter can be thrown away.

SECTION-GAGE FOR JOISTS, COLUMNS, ETC.—WILHELM DOHM, Bielefeld, Germany. The gage or slide rule devised by the inventor ascertains the size of the section required for a joist designed to sustain a certain load. The gage or slide rule will show the size of the required section of the joist for any load, length of joist, and safe limit of stress.

STOP FOR CUT-OFF SAWS.—AMOS W. MILLEN, Overton, Cal. The invention is an improvement in stops or gages used in connection with saws for cutting timber into lengths for boxes or the like. The construction is such that the stop can be quickly changed for different lengths while the saw is in motion.

COLUMN.—JOSEF A. OHMAN, Manhattan, New York city. This column is to be used in the construction of fireproof buildings, the object being to make the column light, yet strong, and to enable the sections to be readily formed by rolling.

DETECTOR DEVICE FOR BOTTLES, ETC. —EDWIN J. BROWN, Oneida, N. Y. The invention is an improvement in devices for preventing the filling of glass bottles or jars with glass tops. Ordinarily such devices are part of the bottle or require some change in its shape. This invention does not affect the bottle and requires no change in its shape. After the receptacle has been used once it can be used again for the same or for other purposes. The detector device, however, can be used but once, for it is destroyed immediately by the mere uncovering of the receptacle.

TRUNK-HANDLE. — BERTNIE M. WILHITE and FRANK A. HOYT, Gordon, Neb. The purpose of this invention is to provide a handle for trunks, which when grasped by a person will not tend to crowd the hand against the side of the trunk. It will, on the contrary, spring outward, so that the trunk can be conveniently lifted and carried. This end is attained by means of a spring which runs longitudinally through the handle.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

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Inquiry No. 783.—For machinery for the manufacture of brass disk pins.

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Inquiry No. 792.—For a machine for making large wooden bowls or trays.

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Inquiry No. 794.—For parties to make battery carbons according to specifications.

Inquiry No. 795.—For a good, second-hand incandescent dynamo from 200 to 800 or 1,000 lights.

Inquiry No. 796.—For information for lighting small towns with acetylene gas.

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Inquiry No. 798.—For parties to make acetylene gas generators to order.

Inquiry No. 799.—For sheet metal workers.

Inquiry No. 800.—For a directory of American iron manufacturers containing a list of such concerns using annealing furnaces of whatever type.

Inquiry No. 801.—For manufacturers of show case materials, such as show case moldings, etc.

Inquiry No. 802.—For a small ozone generator for commercial use.

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Inquiry No. 803.—For dealers in small bevel gear wheels in large quantities and of special dimensions.

Inquiry No. 804.—For a boiler run by crude petroleum, gas or gasoline.

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Inquiry No. 807.—For a machine for automatically cutting and shaping sticks.

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Inquiry No. 810.—For bluing in dry paper form in quantities.

Inquiry No. 811.—For manufacturers of water regulators attached to the meter to control pressure.

Inquiry No. 812.—For manufacturers of can labeling machines,

Inquiry No. 813.—For manufacturers of sponge in sheets or shapes to order,

Notes & Queries

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.

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Scientific American Supplements referred to may be had at the office. Price 10 cents each.

Books referred to promptly supplied on receipt of price.

Minerals sent for examination should be distinctly marked or labeled.

(8199) J. E. H. asks: 1. How to tin a soldering iron. A. File the bolt clean over the part to which the tinning is to be applied. Wet this part with soldering fluid. Heat the bolt till it is hot enough for use and rub it into solder placed upon a piece of tin. If this does not secure an even coating, heat the bolt again and attend to the bare spots in the same manner as before. If you use a soldering pot, you can keep sal-ammoniac on top of the solder, and dip the iron into the solder through the liquid. 2. How to magnetize steel so as to use it as a tack hammer. A. Forge the hammer of good tool steel and harden the ends. Then magnetize by a dynamo or by another magnet in any of the modes which have recently been described several times in this column. 3. Some process for hardening steel and also be tough. I want to know this, as I use chisels in my work. A. We fear you are asking an impossibility. Woodworking chisels are tempered so high that they are of necessity brittle. If they were tempered low, they would be too soft to hold an edge.

(8200) E. T. asks: 1. In any form of magnet does it increase the magnetism to any practical extent by winding near the poles, all conditions being equal? A. All conditions being the same, the magnetizing force is proportional to the number of ampere turns, without reference to the arrangement of the turns. But the length of the circuit affects the number of lines of force inversely. The longer the circuit the fewer the number of lines. The form of the magnet must be determined by the space at one's disposal, and the circumstances. 2. Does it increase the magnetism by spreading the winding over a larger area than by winding in a bunch? A. A turn of wire near the core is very much shorter than one further away. Hence it requires less copper if the magnet is made longer. Here a balance must be struck between length and diameter, according to the particular case. 3. How can I make a depolarizing salt cell? A. All closed circuit cells have depolarizers; the Daniell's or the gravity are the most constant of these. See SUPPLEMENTS Nos. 157, 158, 159, price ten cents each. Sulphate of copper is the depolarizer used in these cells. 4. Can the speed of a motor be controlled by allowing the current to pass through part of the winding on the field and switching on the rest as required? A. To a certain extent.

(8201) F. M. asks: Can you inform me how to make a good dry battery, or where I can get a book on the same? A. Consult SUPPLEMENTS Nos. 792 and 1001, price ten cents each.

(8202) A. B. C. asks: Where and at what price can I get a book treating in scientific fashion such recent advances in electricity as wireless telegraphy? If the book also contains such matters as the X-ray, so much the better. A. We can send you Fahie's "History of Wireless Telegraphy," price $2 by mail; Bottone's "Radiography," price $1 by mail; Headowcroft's "A B C of the X-ray," price $1 by mail; "Experimental Science," $4.

(8203) C. D. C. writes: In the making of a barometer I have tried your suggestion of placing wax in the bottom of the mercury cistern for the purpose of excluding air from the tube at the instant of inverting it. My tube having a bore of ⅛ inch or less, the wax plugged it up entirely. I would suggest cutting a small square of leather from a kid glove, of a size to amply cover the end of the tube. With a heated table knife melt beeswax into this patch until it is saturated, leaving no excess of wax on the surfaces. Stick this patch on the end of the tube, turn the empty cistern down over it so that the patch shall be safely held between the tube and the bottom of the cistern. Hold securely and reverse carefully. When in the upright position pour mercury into the cistern until it is one-third or one-half full; then, with a needle, get hold of a corner of the kid, and by careful manipulation get it from its place on the tube. There is no difficulty in this method. The filling of a barometer tube is a rather troublesome operation by any ordinary process. I have found the following method quite simple and convenient: Provide first a perfectly straight iron (not brass or copper) wire somewhat longer than the tube, and much smaller than the bore of the tube. Next roll up a small funnel of stiff writing paper and pin it together. Make the small end fit closely around the tube, then with a heated table (or other smaller) knife seal the lap of the paper with beeswax and fill between the paper and the glass with the wax. If this work is done near a stove or radiator the wax will work better and adhere more surely. By placing a teaspoonful of mercury at a time in the funnel, and then using the wire as a plunger within the tube, the air gets out and the mercury in without trouble or loss. A. These suggestions are very practical. We would add that it is usual to attach to the bottom of the iron wire a piece of soft leather or cloth to act as a scraper and detach the air bubbles from the glass as the plunger is drawn up. Thus the air is almost completely removed as the tube is filled. There is, however, no method of getting rid of air completely and with certainty except to boil the mercury in the tube itself. The trouble with the wax could be avoided by using harder wax.

(8204) A. K. D. asks: 1. Can I learn what kind of wire, what size, and how much of it should be used to make a very high resistance, say to carry 15 or 18 milliamperes, suitable for battery purposes, from 2 to 8 volts? A. To obtain the current which you wish at the pressures you specify will require resistance as follows:

18 milliamperes at 2 volts...111 ohms.
15 milliamperes at 2 volts...133 ohms.
18 milliamperes at 8 volts...444 ohms.
15 milliamperes at 8 volts...533 ohms.

This does not take into account the resistance of the external circuit, outside the resistance box, an element which we do not know. You can allow for this and deduct from the resistances given above. Probably No. 34 German silver wire will carry the current without overheating. This has about 0.3 foot per ohm. About 180 feet may be taken and made into a variable resistance with, say, 10 points. You will then have the range you desire, with a finer adjustment than you specify. SUPPLEMENT No. 1210, price ten cents, describes such a construction of rheostat. 2. In answer to query 8088, March 9, 1901, in reference to lightning rods, you say: "They act as a path from the earth up into the clouds to neutralize electricity before lightning strikes." Would not rods do that part better if run up much higher than they usually are on buildings? Also if rods were thickly distributed over the country sufficiently high, could not thunder storms be altogether avoided or prevented? A. With reference to preventing thunderstorms by numerous lofty lightning rods, we fear you cannot succeed. The suggestion has been made to dissipate tornadoes in this way, but it is not possible to provide points enough to carry sufficient electricity into the upper air to accomplish the result. Nature's dynamos can generate faster than man's rods can neutralize the product.

(8205) W. H. W. writes: In one of your late issues of the SCIENTIFIC AMERICAN, under "Notes and Queries," it was stated in effect that pure water was a non-conductor of electricity, although even a trace of acid might make it otherwise. So I take the liberty of handing you herewith an account of a recent fire in our city, in the Edison Electric Light Company's power house, wherein it states that "knowing well the conductive features of a stream of water, which is a perfect pathway for an electric current, the firemen elected to fight it with their chemical apparatus," etc. A. The firemen did quite right to take no chances in subduing the fire in the lighting station. Common water is far too good a conductor for their use of it in such a place. The slightest trace of impurity renders it so, whatever the character of the impurity. Yet there is no water which is a "perfect pathway for the electric current." No electrician could have written that statement. Water is often used as a resistance: but it is usually necessary to add salt to the water in order to reduce its resistance still further before it can be so used. This would not be done if water were even a good pathway for electricity, and if water were a perfect pathway for electricity it would not be possible to use it for a rheostat, since it would offer no resistance at all. Perhaps it would be right to say that water does not offer resistance to lightning, since the voltage of lightning is so enormous that any ordinary resistance is as nothing before it. To all ordinary voltages, however, water, chemically pure water, is a non-conductor, and by that term we do not mean water good enough to drink, but water containing nothing else but H_2O, water in the sense in which a chemist uses the term, pure water. Thompson, in his "Elementary Lessons in Electricity," gives the resistance of "pure water" as 26,500,000,000, when the same quantity of copper would have a resistance of 1.57. If pure water is not a non-conductor, what is it?

NEW BOOKS, ETC.

PRACTICAL ELECTRO-CHEMISTRY. By Nertram Blount. New York: The Macmillan Company. Westminster: Archibald Constable & Company, Limited. 1900. Pp. 373.

This volume, as its title indicates, deals with the practical side of one of the youngest and most promising of modern industries—electro-chemistry—and shows the advantages gained in many instances by its use. An introductory chapter on the general principles of the science is followed by chapters on electro-chemical processes which have been already or are likely soon to be turned to industrial use. A review is made of the electro-chemistry of the different metals and a comparison given with the old processes. A chapter is devoted to the reduction of metals in the electric furnace as practised to-day. Another chapter is given up to the electrolytic manufacture of organic compounds and fine chemicals, and the book concludes with a discussion of the efficiency of the existing methods of producing electrical power, in which the carbon and gas cells are described.

This work will be found of much interest to any one interested in the science, and will also be of use as a guide to those engaged in the practical application of electricity to chemistry for industrial purposes.

EXPERIMENTAL PHYSICS. By Eugene Lommel. Translated from the German by G. W. Myers. London: Kegan Paul, Trench, Trübner & Company, Limited. Philadelphia: J. B. Lippincott Company. 1900. Pp. 664. With 430 figures in the text.

This work, by Prof. Lommel, of Munich, is the outcome of a series of experimental lectures on physics, and is noteworthy for the clear, concise exposition of the principles of the science and their constant application to practical, everyday uses. It is this practical application of principles that renders this work especially valuable to the beginner, as the principle is firmly fixed in the reader's mind by its practical application. Numerous simple experiments illustrative of principles involved are also given. The subject is presented in its historical sequence as far as possible; and this edition, which is the third, contains a discussion of the Roentgen rays, and a new plate showing the spectra of the sun and of several of the elements. The book contains numerous notes in fine print which still further develop the subject and make it useful as a book of reference for advanced students.

THE CHEMIST'S POCKET MANUAL. By Richard K. Meade, B.S. Easton, Pa.: The Chemical Publishing Company. 1900. 16mo tuck. Pp. 204. Price $2.

A practical handbook containing formulas, calculations, physical and analytical methods for the use of chemists, assayers, metallurgists, manufacturers and students. It is a most valuable book, it is a time saver and is eminently practical. We strongly commend it.

SUR LES NIDS DE LA VESPA CRABRO. Ordre d'apparition des premiers alvéoles. Par Charles Janet.

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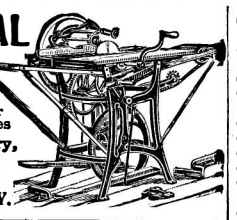

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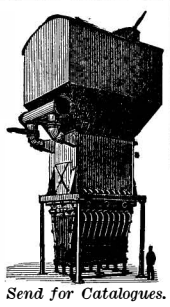

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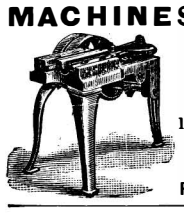

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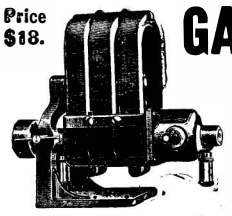

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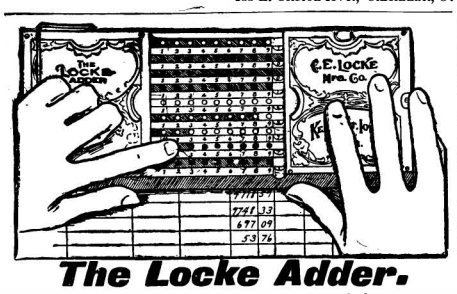

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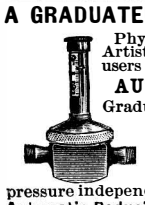

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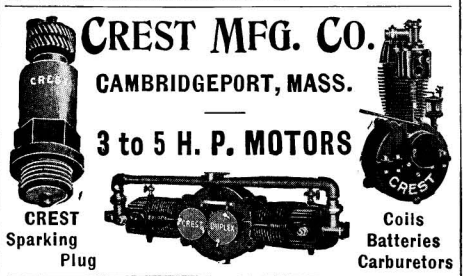

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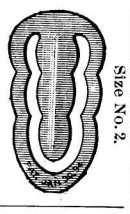

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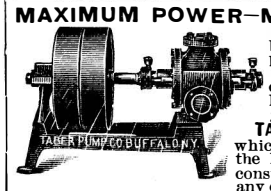

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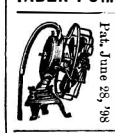

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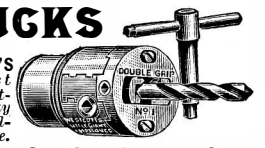

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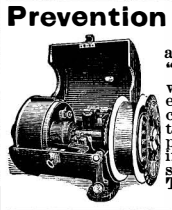

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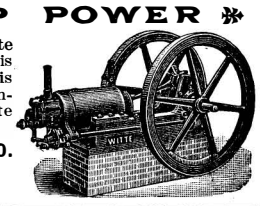

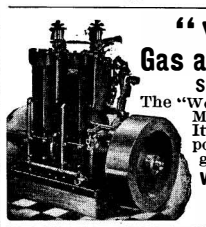

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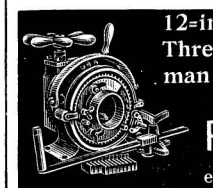

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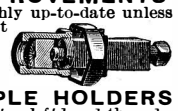

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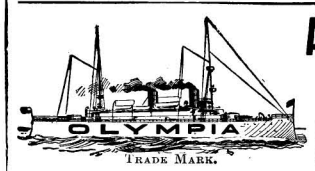

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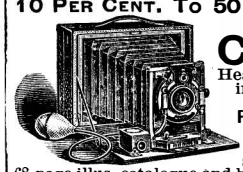

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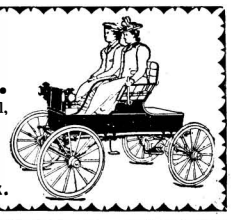

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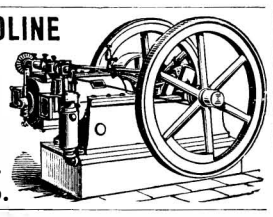

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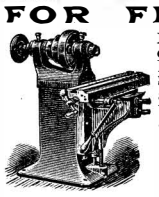

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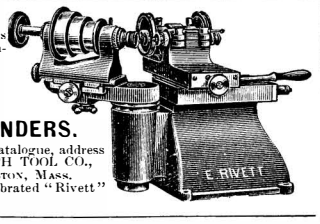

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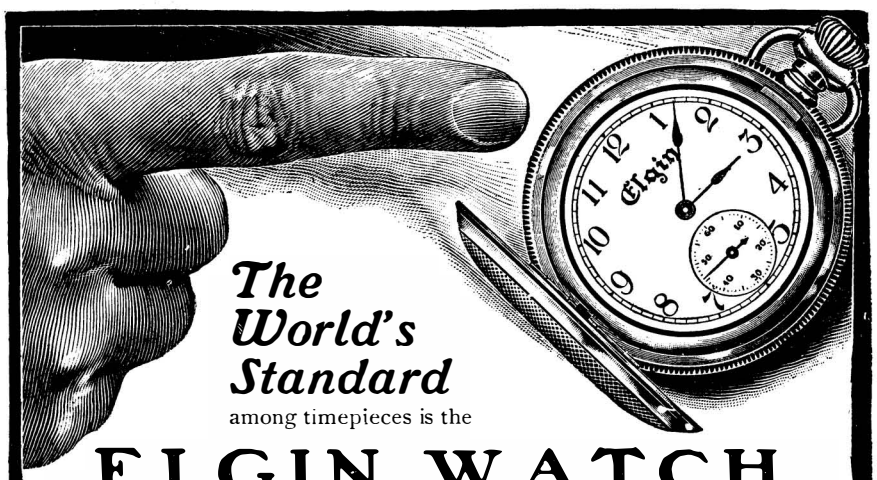

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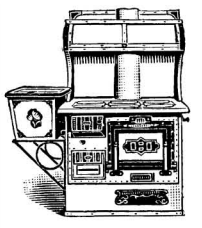

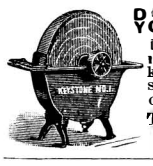

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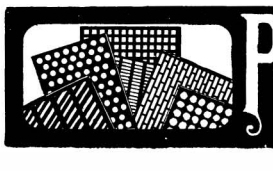

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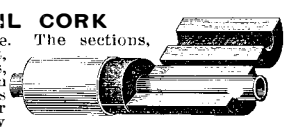

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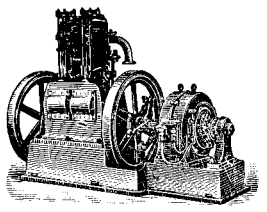

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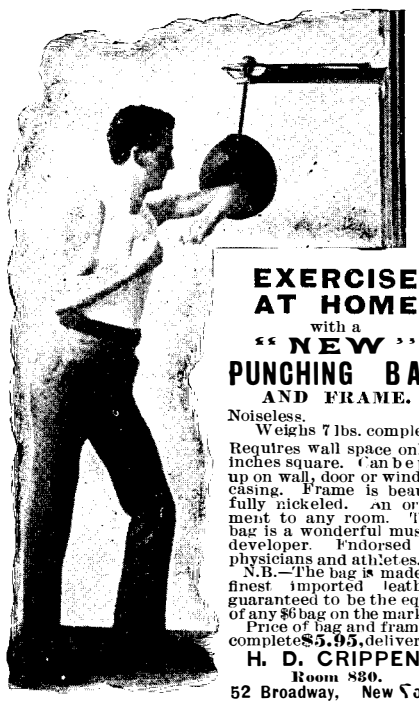

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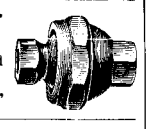

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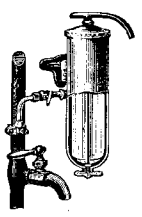

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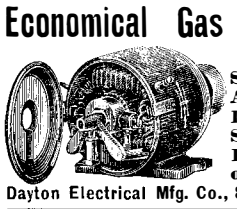

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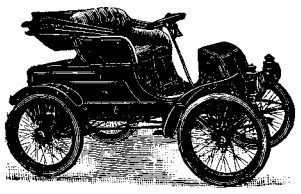

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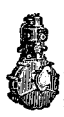

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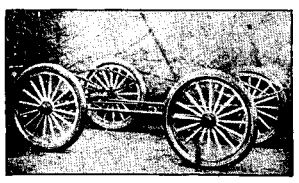

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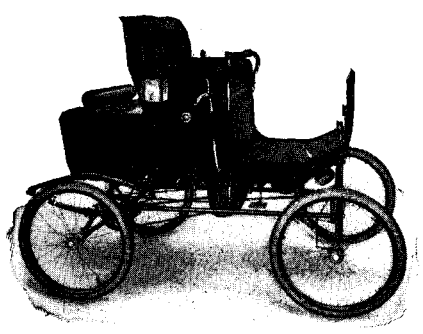

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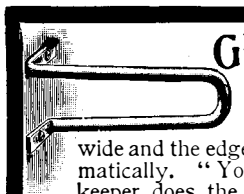

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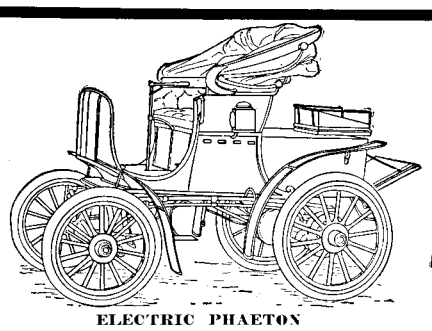

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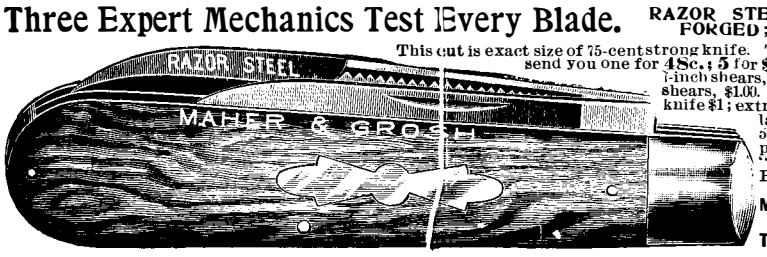

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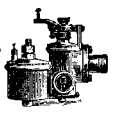

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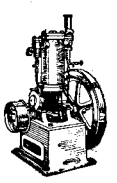

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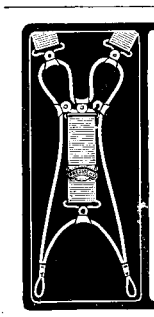

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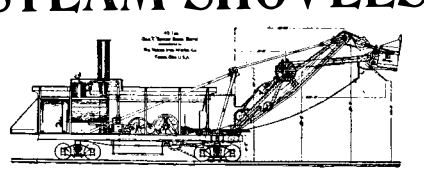

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